1

INSTRUCTION MANUAL

for

R-1735/URR

RADIO RECEIVER

Do Not Sell.

INSTRUCTION MANUAL

for

R-1735/URR

RADIO RECEIVER

GALAXY ELECTRONICS INC.
a subsidiary of
HY-GAIN ELECTRONICS CORP.
R.R.3
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SECTION 1

GENERAL DESCRIPTION

1.1 GENERAL

The Galaxy FFR-230 solid-state fixed frequency receiver is designed for highly reliable applications, both fixed and portable, demanding extreme accuracy and stability. The FFR-230 has a unique multiple filter to allow for quick change of bandwidth for optimum performance in receiving SSB, AM, CW, FAX or FSK signals. Outputs are provided for operation of auxiliary equipment making the FFR-230 a versatile and highly reliable piece of equipment.

1.2 APPLICATIONS

The Galaxy FFR-230 has been designed for military use demanding maximum frequency stability and intelligibility where superior SSB, CW, FSK and AM reception is desired. Use of solid state technology provides better reception under adverse conditions while providing a receiver that is easily maintained in the field. The receiver is light in weight, small in size, produces little or no heat and operates over a wide temperature range. This compact packaging allows two receivers to be placed in a single 19" rack mount conserving space in military applications.

1.3 FEATURES

Size	8 3/8" W x 7" H x 16" D
Weight	13 lbs.
Front Panel Controls	Clarifier, Band Switch, AF (volume), Function, Meter AF/RF, Preselector (tuning), Selectivity, and Ant Trim (screwdriver adjust).
Front Panel Outputs	Phones
Rear Panel Outputs	Audio, 8 Ohms and 600 Ohms
Rear Panel Inputs	Antenna, Power and Mute
Power Requirements	115/230 VAC, 50-60 Hz or 14-18 VDC, Power - 15 Watts Nominal
Remote Control Provisions	External Mute
Accessories:	
RPA-230	Rack Panel Adapter - Facilitates mounting two FFR-230 receivers in a standard 19" rack.
NF-230	Rejection Notch Filter - Provides an extremely narrow rejection notch in the IF passband of the FFR-230 receiver for removing interferring hetrodynes or unwanted CW signals. The chassis mounted module has front panel controls for Frequency ($\pm$ 5 KHz) and Notch Depth. The Depth control has an OFF position which removes the Notch Filter from the circuit when not in use.

1.4 SPECIFICATIONS

Frequency Range	2 to 30 MHz, crystal controlled.
Modes	AM, Selectable UPPER and LOWER Sideband, RTTY (wide and narrow band) and CW.
Frequency Stability	±2.5 parts per million or ± 20 Hertz whichever is greater over the temperature range of - 30°C to + 50°C.
RF Input Impedance	50 ohms unbalanced.
Sensitivity	AM: better than 3 uv for 10 db (S + N)/N, 30% mod, 6 KHz bandwidth. All other modes: better than .5 uv for 10 db (S + N)/N.
Selectivity	
AM	6.0 KHz @ 6 db, 24 KHz @ 60 db.
LSB	2.1 KHz @ 6 db, 8.4 KHz @ 60 db.
USB	2.1 KHz @ 6 db, 8.4 KHz @ 60 db.
RTTY (USB)	1.7 KHz @ 6 db, 6.8 KHz @ 60 db. 2250 Hz center frequency.
RTTY (USB)	0.6 KHz @ 6 db, 2.7 KHz @ 60 db. 2000 Hz center frequency.
CW (USB)	0.6 KHz @ 6 db, 2.7 KHz @ 60 db. 700 Hz center frequency.
AVC	1 uv to 300,000 uv will cause less than 6 db change in audio output.
Audio Output	0.5 watts, 8 ohms on front and rear panel, 600 ohms center-tapped on rear panel.
Audio Output Distortion	Less than 5% at 0.5 watts.
Audio Frequency Response	300 Hz to 2800 Hz, within 6 db.
Metering	R. F. - Calibrated 0 to 80 db. AF - Calibrated -6 to + 6 db. (Reference 1 mw, 600 ohms.)
Image Rejection	60 db or greater 2 thru 16 MHz. 38 db or greater 16 thru 30 MHz.
Spurious Rejection	
External	60 db or greater below desired signal.
Internal	Not more than five internal spurious responses greater than 1 uv (primarily harmonics of 1703.226 KHz oscillator).
Intermodulation Distortion	-55 db third order for 1000 uv input.
Cross Modulation Performance	Reference Signal (F1) = 100 uv.

Test Signal Frequency at 30% Modulation	Test Signal Level to Product 10% Modulation of the Reference Signal
F1 + or - .01 F1	20,000 uv
F1 + or - .02 F1	30,000 uv
F1 + or - .04 F1	100,000 uv
F1 + or - .08 F1	500,000 uv
F1 + or - .16 F1	3.0 volts
F1 + or - .32 F1	Greater than 3.0 volts

1.4 SPECIFICATIONS (con't)

Receiver Overload	1 volt RMS will not cause damage. 1/2 volt signal intelligible.
Environmental Conditions	Temperature Range -30°C to +50°C.

SECTION 2

INSTALLATION

2.1 UNPACKING

Carefully remove the Galaxy FFR-230 from the packing carton. Examine it closely for signs of shipping damage. Remove all hold-down tape and check to insure that all transistors and crystals are properly seated in their sockets. Inspect closely for any signs of internal damage.

Should any shipping damage be apparent -- NOTIFY THE DELIVERING CARRIER IMMEDIATELY! State to the carrier the full extent of the damage and file a claim IMMEDIATELY!

Fill out the enclosed WARRANTY REGISTRATION CARD and mail it TODAY to insure that your warranty will be properly validated.

Save the packing material and the shipping carton. You may need it at a later date for shipment or storage of the transceiver.

After you are satisfied that no damage has resulted from shipment, and have removed all tape and insured that all crystals and transistors are properly seated in their sockets, replace the cabinet.

2.2 RACK-MOUNTED INSTALLATION

The FFR-230 may be rack mounted requiring only 1/2 of a standard 19" rack panel, 7" high. This allows two FFR-230 receivers to be mounted in the same 19" rack panel as shown in Figure 1. The rack mounting chassis is provided with standard RETMA spacing on the rack mounting screw notches.

2.3 MOBILE INSTALLATION

For mobile use, the FFR-230 receiver should be shock mounted. If the vehicle in which the receiver is to be installed is not for travel over rough terrain or will not be subjected to violent acceleration or deceleration in any plane, the FFR-230 may be used without shock mounting.

2.4 POWER REQUIREMENTS

2.4.1 115 VAC -- The FFR-230 is factory wired for operation from 115 VAC, 50-60 Hz. Refer to Figure 2 to check the proper connections for 115 VAC operation.

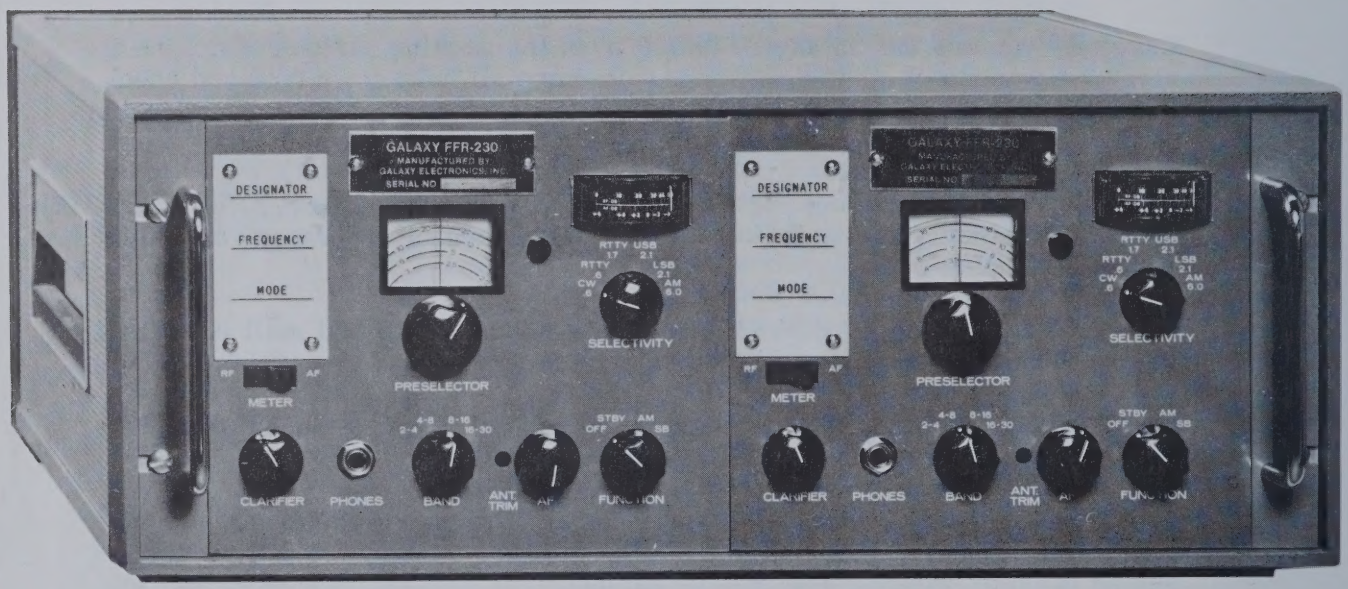
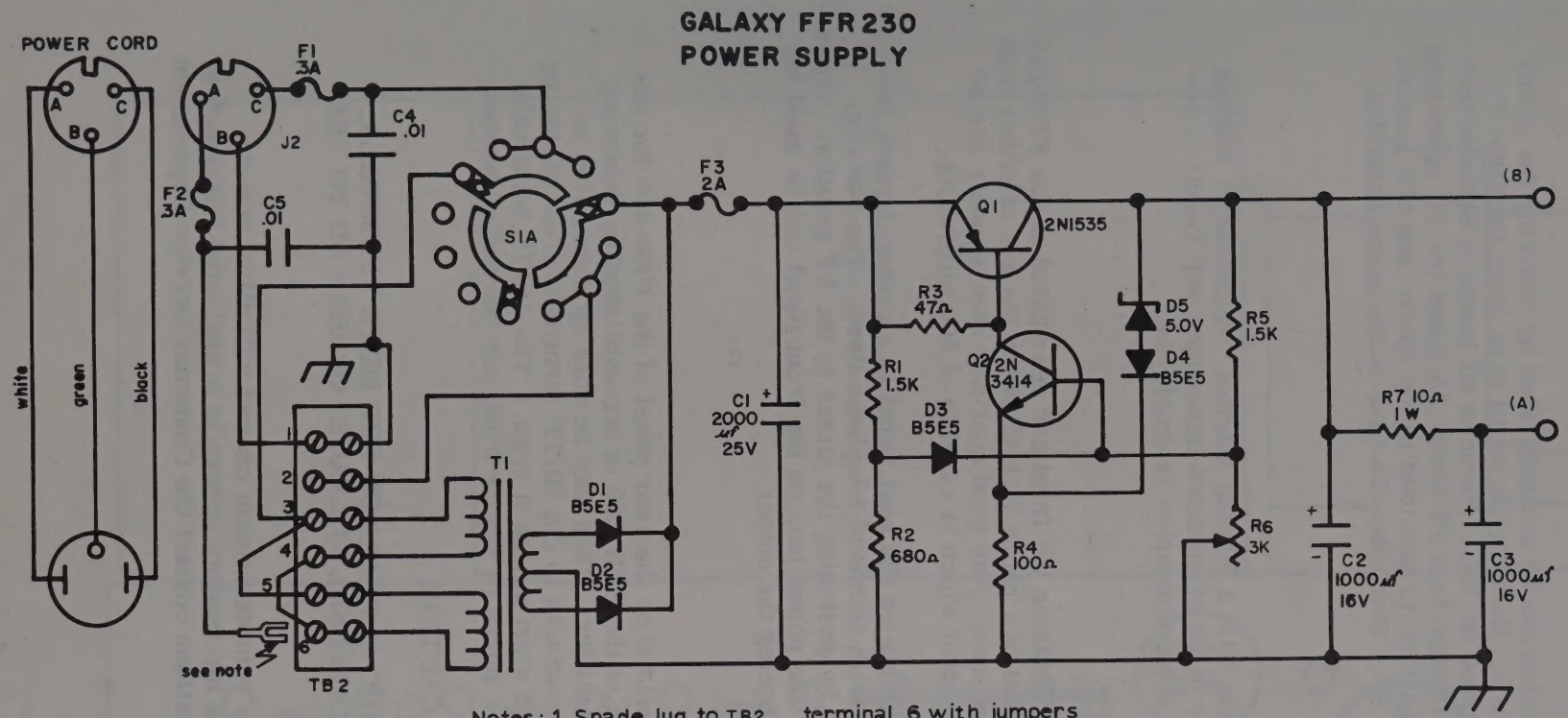


FIGURE 1. RACK MOUNTED INSTALLATION



Notes: 1. Spade lug to TB2 . terminal 6 with jumpers from 4 to 6 & 3 to 5 for 115VAC operation only
Other voltage applications shown below.

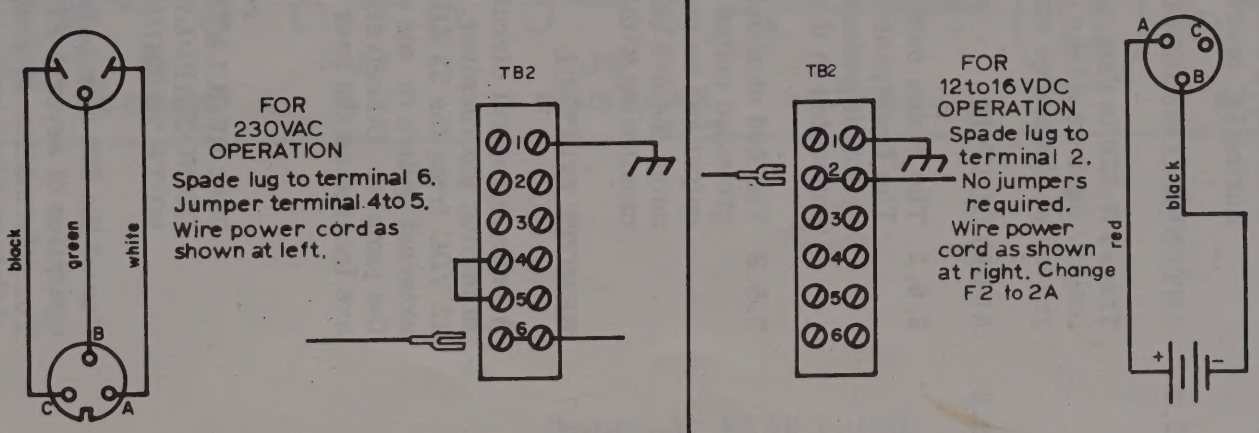


FIGURE 2. POWER CONNECTIONS

2.4.2 230 VAC -- The FFR-230 may be operated from 230 VAC by changing the power cord connections as shown in Figure 2. Remove the jumpers between 3-5 and 4-6. Place a jumper between 4-5.

2.4.3 14-18 VDC -- DC operation can be accomplished by rewiring the power cord as shown in Figure 2. Remove the white wire from terminal 6 and connect it to terminal 2 on TB2. Remove all jumpers between terminals 3, 4, 5 and 6. Change fuse F2 from .3A (used for AC operation) to AGC-2A. An AGC-2A fuse is provided in the spare fuse clip located under the chassis near F3. Store the .3A fuse in the spare fuse clip during DC operation.

2.5 ANTENNA CONSIDERATIONS

The FFR-230 is designed for use with a 50 ohm antenna. Antennas of random length, such as a long wire, or those of unknown impedance will result in degraded performance unless an antenna coupler is employed.

2.6 AUDIO OUTPUT

2.6.1 The 8 ohm output is available on the front and rear panel of the FFR-230. The front panel connection is a phone jack allowing the use of either high or low impedance headphones. Any good quality 8 ohm speaker can be connected to the 8 ohm output which is capable of 500 milliwatts.

2.6.2 The 600 ohm output available on the rear panel is a center-tapped, ungrounded output for use with standard telephone lines. The 600 ohm output can be monitored by switching the meter to the AF position. When using the 600 ohm line, the phone jack on the front panel can be used for monitoring without disrupting the output.

2.7 REMOTE CONTROL

A remote control circuit is provided on the rear panel of the FFR-230 for use in muting the receiver. Muting of the FFR-230 is accomplished by removing 12 VDC from the 53 KHz IF Amplifier. This may be done by connecting an external switch or set of relay contacts to the MUTE terminals after removing the jumper. (Receiver is muted when switch if open.) The MUTE terminals are located on the rear panel as shown in Figure 3 and are normally shorted.

CAUTION

THE REGULATED 12 VDC APPEARS ON THE MUTE TERMINALS. DO NOT APPLY ANY EXTERNAL VOLTAGES OR GROUND TO THE MUTE TERMINALS.

Use of the 600 ohm output and a remote volume control will allow remote operation of several FFR-230's for random access to preselected frequencies. For information on such applications contact the Customer Service Department of Galaxy Electronics.

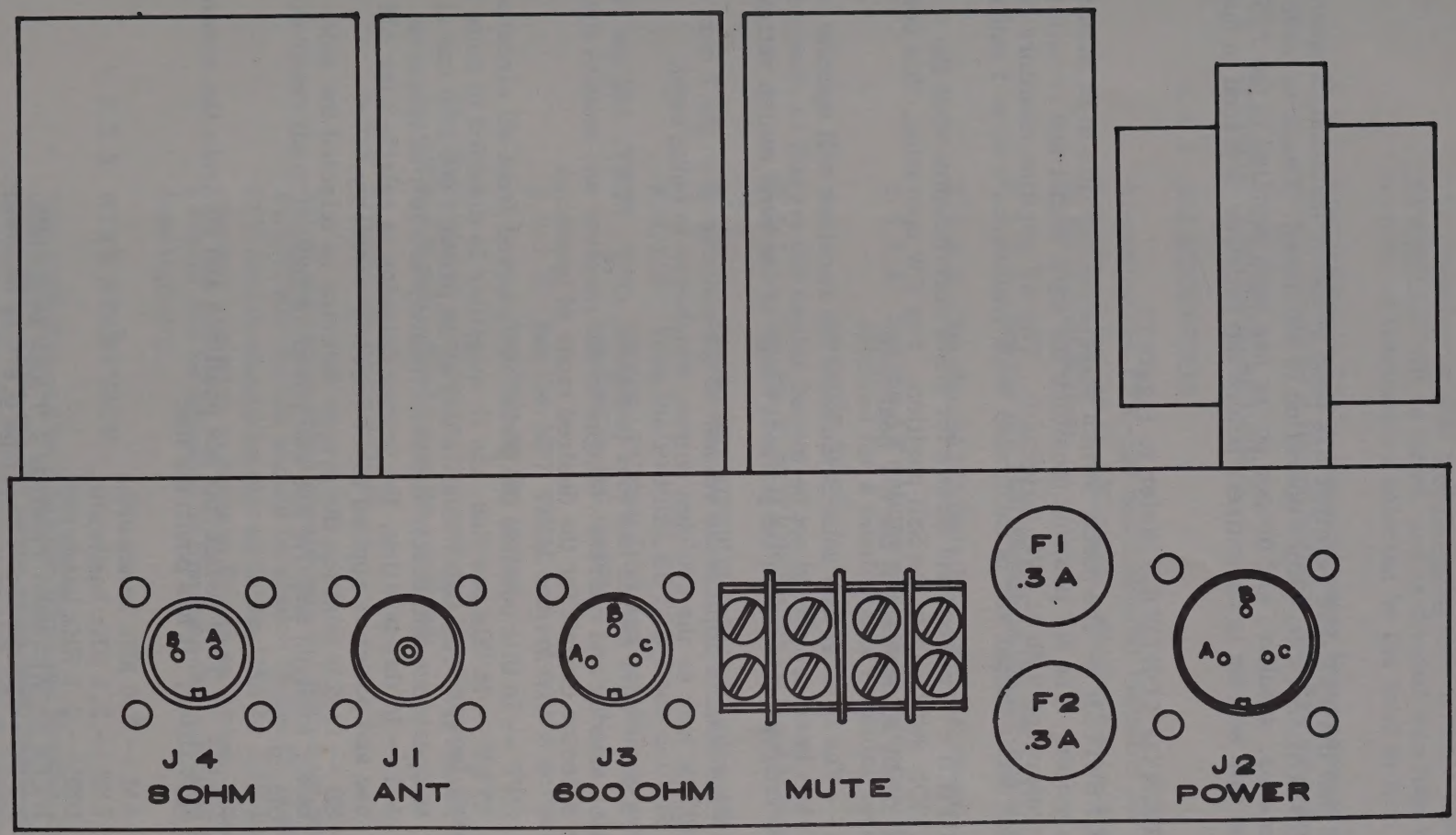


FIGURE 3. REAR PANEL

SECTION 3

OPERATION

3.1 GENERAL

It is assumed that the FFR-230 receiver has been properly installed as specified in Section 2 (INSTALLATION) before operation is attempted. Check to make certain the antenna, speaker, and proper power has been supplied to the FFR-230, then read this section in its entirety before the receiver is placed in operation.

3.2 IDENTIFICATION OF CONTROLS (Refer to Figure 1)

3.2.1 METER SWITCH -- The meter switch selects the circuits to be monitored by the meter. The RF position monitors the input signal and is calibrated in db (reference 0 db at AVC threshold). The AF position monitors the 600 ohm audio output and is calibrated in db (reference 0 db at 1 milliwatt).

3.2.2 CLARIFIER -- This control allows for voice clarification when the FUNCTION switch is in the SSB position. For CW operation, this control allows slight adjustment of the CW beat note.

3.2.3 BAND -- The band switch selects the band the receiver will operate in, and once it has been set should not be moved unless the crystal is changed, and the new frequency is not in the present range of the band switch setting.

3.2.4 AF -- This control adjusts the volume of the audio level to the 8 ohm output, The PHONE jack or the 600 ohm output, whichever is being used.

3.2.5 FUNCTION -- This switch has four positions, OFF, STBY, AM and SB. It applies standby and operate voltages to the receiver and selects the proper detector circuit for the desired mode of operation.

- OFF -- In this position the power is removed from all circuits.
- STBY -- In this position, the IF amplifier is disabled to mute the receiver. The audio level is left at its present position and all temperature and heater control circuitry are left in operation.
- AM -- In this position, the proper detector is selected for AM use and power is applied to all receiver circuitry.
- SB -- In this position the proper detector is selected for sideband, teletype and CW use and power is applied to all receiver circuitry.

3.2.6 SELECTIVITY -- This switch has six positions and controls the special 53.226 KHz filter. It has positions for:

- AM -- 6.0 KHz bandwidth.
- LSB -- 2.1 KHz bandwidth.
- USB -- 2.1 KHz bandwidth.
- RTTY -- Wideband Teletype 1.7 KHz bandwidth.
- RTTY -- Narrowband Teletype 0.6 KHz bandwidth.
- CW -- 0.6 KHz bandwidth.

3.2.7 PRESELECTOR -- This knob tunes the receiver RF Amplifier to the proper frequency and should be tuned for a peak reading on the meter. The preselector dial indicates the approximate frequency to which the PRESELECTOR is tuned, and is divided into four bands to correspond with those frequencies selected by the band switch.

3.2.8 ANT TRIM -- The antenna trimmer is a recessed screwdriver type control which serves as a fine adjustment for matching the receiver to the antenna.

3.3 TYPICAL CONTROL SETTINGS

3.3.1 AM RECEPTION

Assuming the FFR-230 has a crystal installed for 10 MHz operation and you are tuning for an AM signal, which on this frequency would be WWV in the United States:

3.3.1.1 Set the METER Switch to the RF position.

3.3.1.2 Set the BAND Switch to the 8-16 range.

3.3.1.3 Set the AF volume control to mid-range. This can then be re-adjusted for a comfortable listening level when the FFR-230 is properly tuned.

3.3.1.4 Set the FUNCTION Switch to the AM position.

3.3.1.5 Set the SELECTIVITY Switch to the AM 6.0 position.

3.3.1.6 Tune the PRESELECTOR Knob until 10 MHz appears on the PRESELECTOR Dial and continue to tune for a maximum reading on the meter.

3.3.1.7 Set the ANT TRIM control with a screwdriver for maximum reading on the meter.

The Receiver is now properly tuned and the National Bureau of Standards (Standard Time Signal) should now be received.

3.3.2 SIDEBAND RECEPTION

All of the above steps should be used with only two exceptions: The FUNCTION Switch should be placed in the SB position and the SELECTIVITY Switch should be placed in the USB or LSB position depending on whether you wish to receive Upper or Lower sideband. The CLARIFIER Control can be adjusted to fine tune the sideband station for maximum intelligibility.

3.3.3 RTTY RECEPTION

The FFR-230 can be used for Wide and Narrow band RTTY reception. All controls are set the same as in SIDEBAND operation with the exception of the SELECTIVITY Switch which is placed in RTTY 1.7 for

Wide Shift 2550 Hz center frequency and RTTY .6 for Narrow Shift 2000 Hz center frequency reception.

3.3.4 CW RECEPTION

Receiver tuning for CW reception is the same as for SIDEBAND and RTTY reception with the exception of the SELECTIVITY switch which is placed in the CW .6 position. The CLARIFIER control is also operative in the CW position and allows for adjustment of the CW beat note.

SECTION 4

THEORY OF OPERATION

4.1 FREQUENCY DETERMINING CIRCUITRY

Frequency determining crystals for the First and Second Oscillators are mounted in a temperature controlled oven assembly for maximum frequency stability. The oven assembly is located directly behind the pre-selector assembly. To determine the frequency of the HFO crystal, the following formulas should be used:

A. For AM and SSB below 16 MHz

$$fa + fb = fc$$

where: fa = carrier frequency Hz
fb = 1,650,000 Hz
fc = crystal frequency Hz

B. For RTTY (FSK) below 16 MHz

$$fd + fb - fe = fc$$

where: fd = center frequency of RF tones $\frac{(f1 + f2)}{(\ 2\ )}$ Hz
fb = 1,650,000 Hz
fe = center frequency of audio tones $\frac{(f1 + f2)}{(\ 2\ )}$ Hz
fc = crystal frequency Hz

C. For CW below 16 MHz

$$fa + fb - 700 = fc$$

where: fa = carrier frequency Hz
fb = 1,650,000 Hz
fc = crystal frequency Hz

D. For all modes above 16 MHz

Calculate as in A, B, or C above and divide by 3 for the desired crystal frequency.

When ordering crystals, specify the crystal frequency and type CR-27/U. The grinding tolerance should be held to .001%.

4.2 BASIC RECEIVER DESCRIPTION

4.2.1 INTRODUCTION

The receiver is a completely solid state dual-conversion superheterodyne unit. The intermediate frequencies are 1650 KHz and 53.226 KHz. Refer to the schematic diagram, fold-out in the back of this manual, and the receiver block diagram, Figure 4, while following the receiver circuit description.

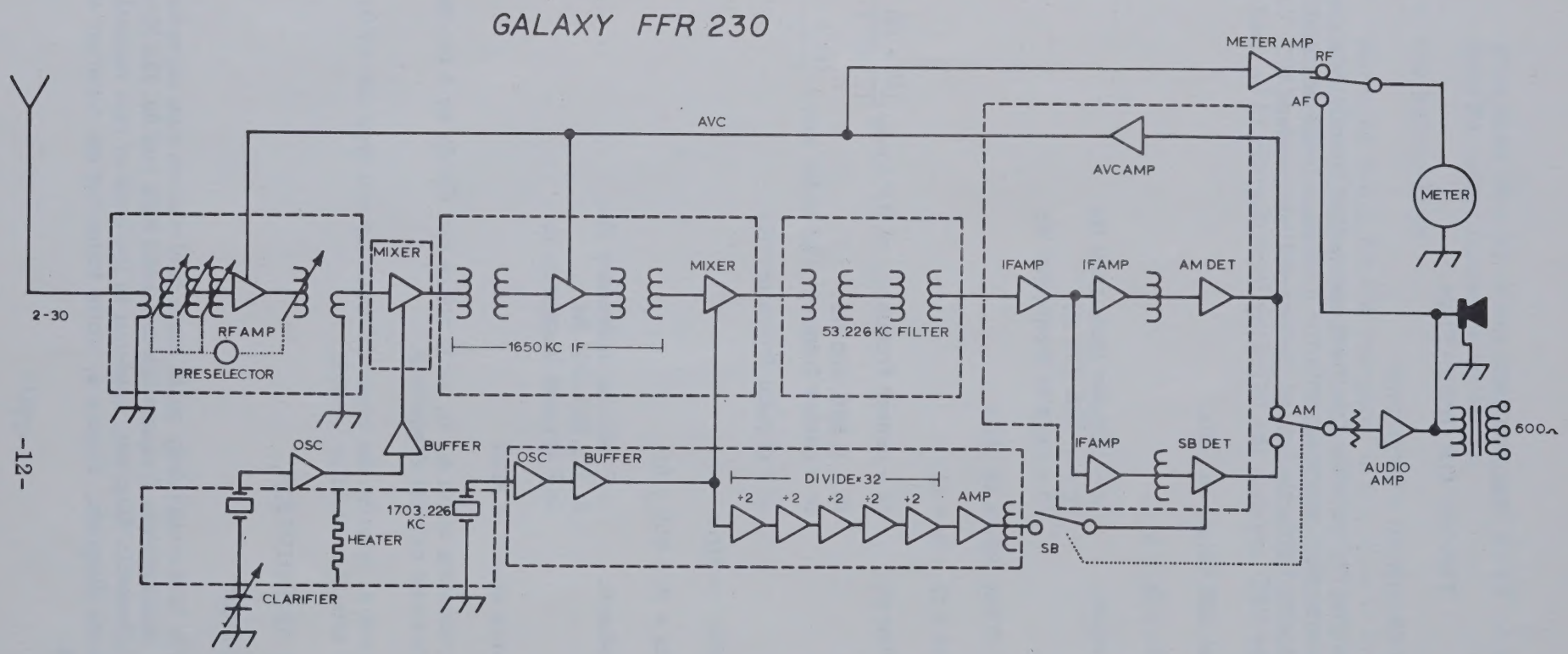


FIGURE 4. BLOCK DIAGRAM

4.2.2 RF AMPLIFIER

The incoming signal from the antenna is coupled to Q101 thru a three pole syncronously tuned Butterworth filter. This filter is designed to keep unwanted signals from the base of Q101. The signal is amplified in a differential amplifier, Q101 and Q102 and passes thru another tuned circuit to the output of the RF amplifier J101. AVC voltage is applied to the bases of Q101 and Q102 to reduce gain on strong signals. The signal at J101 is connected to the balanced mixer, J201.

4.2.3 HIGH FREQUENCY OSCILLATOR

The high frequency oscillator crystal is a type CR-27/U crystal. The crystal is located in a precision oven assembly which controls temperature of the crystal to 75 degrees centegrade. The oscillator is composed of Q701. (This is a special temperature compensated pierce oscillator circuit.) C7 (CLARIFIER) is a front panel control for signal clarification. C8 (FREQ) is a chassis mounted control for trimming the crystal oscillator on frequency. Q702 is a common collector buffer stage and the signal is connected from there to the Balanced Mixer, J202.

4.2.4 BALANCED MIXER

The two input frequencies from the RF Amplifier and the HF Oscillator are mixed in the Balanced Mixer to produce a difference frequency of 1650 KHz. For frequencies between 16 and 30 MHz, the third harmonic of the HFO mixes with the signal from the RF amplifier to produce an IF of 1650 KHz. The output of the mixer is coupled to J203 thru a low pass filter network. The signal at J203 is connected to the 1650 KHz IF Amplifier J301.

4.2.5 1650 KHz IF AMPLIFIER

The 1650 KHz signal from the Balanced Mixer is filtered and amplified in Q301 and Q302. These transistors are in a differential amplifier circuit similar to the RF amplifier. AVC is applied to the bases of Q301 and Q302 to limit their gain on strong signals. The 1650 KHz signal is coupled thru T302 to the Second Mixer, Q303. Also 1703.226 KHz from the Second Oscillator is coupled to the Second Mixer. The output at J303 is 53.226 KHz and is connected to the Multiple Filter, E501.

4.2.6 OSCILLATOR DIVIDER CIRCUITS

The crystal for this oscillator is located in the oven with the HFO crystal. It is a type CR-27/U crystal at 1703.226 KHz. It is connected to Q601 which is a standard pierce oscillator circuit similar to the one used in the HFO. The output of this oscillator is amplified in Q602 and appears on TP601 and J601. A portion of this signal is fed to MC890p integrated circuit divider. This integrated circuit is composed of two JK flip-flops innerconnected to a divide by four circuit. The output of this IC is 425.806 KHz. This signal is fed to a second MC890p which is innerconnected the same as the first MC890p. The

output of this IC is 106.451 KHz. This signal is fed to MC723p integrated circuit which is a single JK flip-flop. The output of this flip-flop is 53.226 KHz. This signal is amplified in Q603. The output appears at TP602 and J602. This divider circuit has its voltage supplied from the function switch and only operates in the sideband position.

4.2.7 MULTIPLE FILTER MODULE

This module contains six seperate four pole Chebishev filters. The band widths and the center frequencies of these filters are switched for the different modes of operation. The specifications for these filters are listed in Section 1.4.

4.2.8 SECOND IF AMPLIFIER

Q401 amplifies the signal from the multiple filter. The output is coupled to IF amplifiers Q402 and Q404. These amplifiers are broadband and require no tuning.

4.2.9 AM DETECTOR

The AM detector is comprised of diodes D401 and D402. They are connected in a standard voltage doubler configuration. The output of this detector is coupled to the AVC circuitry and a low pass filter circuit. The output of the low pass filter is connected to the gain control when the function switch is in the AM position.

4.2.10 SIDEBAND DETECTOR

Q403 receives signals from Q402 (IF amp) and J402 (BFO). The audio output from this stage passes thru a low pass filter and is connected to the audio gain control when the function switch is in the sideband position. The BFO signal which came from the oscillator divider module is only present when the function switch is in the sideband position.

4.2.11 AVC AMPLIFIERS

Q405 is a DC amplifier which receives its signal from the AM detector. The output of this amplifier is coupled to the meter amplifier, the 1650 KHz IF amplifier, and the RF amplifier transistors.

4.2.12 AUDIO OUTPUT CIRCUITS

The input to the audio amplifier integrated circuit (IC 801) is applied from the audio gain control. This audio signal was derived in the AM detector or the sideband detector depending on which position the function switch is in. This input signal is applied to Pin 14. The signal is amplifier in the integrated circuit and its output appears on Pin 7. This output signal is applied to the 600 ohm output connector J3 by way of matching transformers T801. The output signal is also applied to the phone jack on the front panel and to the 8 ohm output connector J4. This signal also appears at the junction of diodes D805 and D806. Diodes D805 thru D809

form a full wave bridge rectifier. The resulting DC voltage is then applied to the front panel meter when the meter switch is in the AF position.

4.2.13 AVC METER AMPLIFIER

The AVC voltage from the output of the AVC amplifiers is applied to Q801 thru potentiometer R816. This potentiometer allows the meter to be zeroed when there is no signal present on the antenna input. The amplified AVC voltage from Q801 is applied to diodes D801 thru D804. These diodes and their associated resistors form a circuit which tends to linearize the DB scale on the front panel meter. The DC voltage from D801 thru D804 is applied to the front panel meter when the meter switch is in the RF position.

4.2.14 POWER SUPPLY AND REGULATOR CIRCUITS

AC Operation

The AC line voltage from the primary power connector J2, is applied thru S1 to transformer T1. The secondary voltage of T1 is rectified by diode D1 and D2. These diodes are connected in a standard full wave bridge circuit. This rectified voltage if filtered by C1 and applied to the series regulator transistor Q1. R6 adjusts the output voltage to 12.2 volts. The primary line is protected by F1 and F2. F3 protects the internal supply and regulator during AC operation.

DC Operation

When the receiver is operated from 14-18 VDC, T1 is bypassed and the source is connected to the series regulator Q1 thru S1. F2 provides protection for the supply and for reverse polarity due to excess current drawn thru D1 and D2. (F2 must be changed to 2A for DC operation.)

SECTION 5

TEST AND ALIGNMENT

5.1 GENERAL

FFR-230 tests and alignment procedures should be performed by qualified personnel only. Anyone of the adjustments or tests described in this section may be performed individually, provided the proper test setup and preliminary adjustments are made. All warnings, cautions, and notes applicable to a particular procedure should be strictly followed. If an abnormal indication is obtained during the performance of the procedures, troubleshooting and repair of the circuit under test is indicated. For general troubleshooting procedures, refer to the appropriate drawings and procedures.

5.2 TEST EQUIPMENT REQUIRED

Radio Frequency Signal Generator - Hewlett Packard 606 A or equivalent (two required).
Frequency Counter - 2 to 30 MHz.
Vacuum Tube Voltmeter - Hewlett Packard 410B or equivalent.
Audio Frequency Generator - Hewlett Packard 200 CD or equivalent.
Special Alignment Tools are provided on the module dust covers.
G. C. Electronics.....#9050-L
G. C. Electronics.....#8606
G. C. Electronics ..... #5009
Coaxial Adapter, BNC to phone jack.

5.3 ALIGNMENT

For the following alignment it is assumed that the FFR-230 is operable and an output can be observed at the speaker and RF meter. If not, refer to Trouble-shooting in Section 5.4.

5.3.1 REGULATOR ADJUSTMENT

Set the FUNCTION switch to SB. Connect a voltmeter to terminal B on A801 to monitor the regulator output. Allow the receiver to operate until the oven cycles as noted by the slight fluctuation of the regulator output voltage. Adjust R6 for a reading of 12.2 $\pm$ .1 volts while oven is on (lower voltage fluctuation). Refer to Figures 5 and 7 for location of A801-B and R6.

5.3.2 RF METER ZERO

Set the METER switch to RF. Set FUNCTION to AM. With no signal input, adjust R816 for zero on meter RF scale. R816 is located on the audio circuit board. Refer to Figure 5.

5.3.3 1703 KHz CRYSTAL FREQUENCY ADJUSTMENT

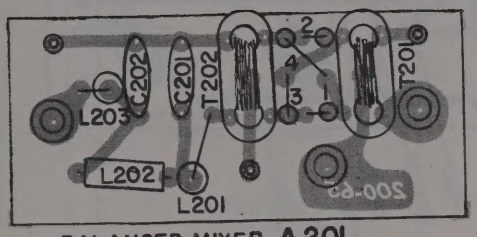
Allow 30 minutes warm-up time before adjusting the 1703 KHz oscillator frequency. Remove the Second Oscillator/ Frequency Divider module cover. Connect the frequency counter to TP601. Adjust C601 so the counter reads 1703226 Hz $\pm$ 5 Hz. Refer to Figures 6 and 7 for location of TP601 and C601. Replace the module cover.

5.3.4 1650 KHz IF ALIGNMENT

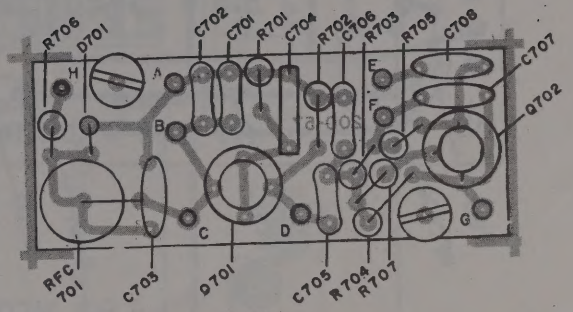
Connect the signal generator to the ANT jack J1. Set FFR-230 controls as follows:

FUNCTION ..... SB
METER ..... RF
SELECTIVITY 2.1
CLARIFIER ..... Mid- Range
AF ..... Mid- Range

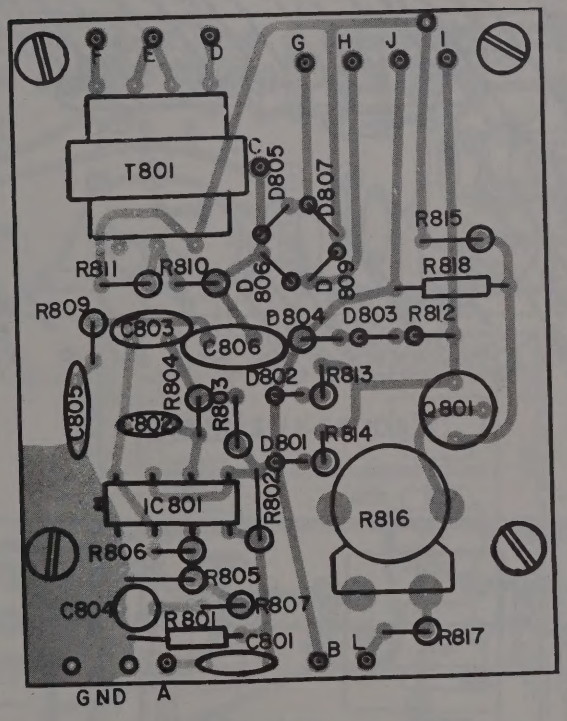
Check that the BAND switch and PRESELECTOR dial are set to the proper



BALANCED MIXER A201

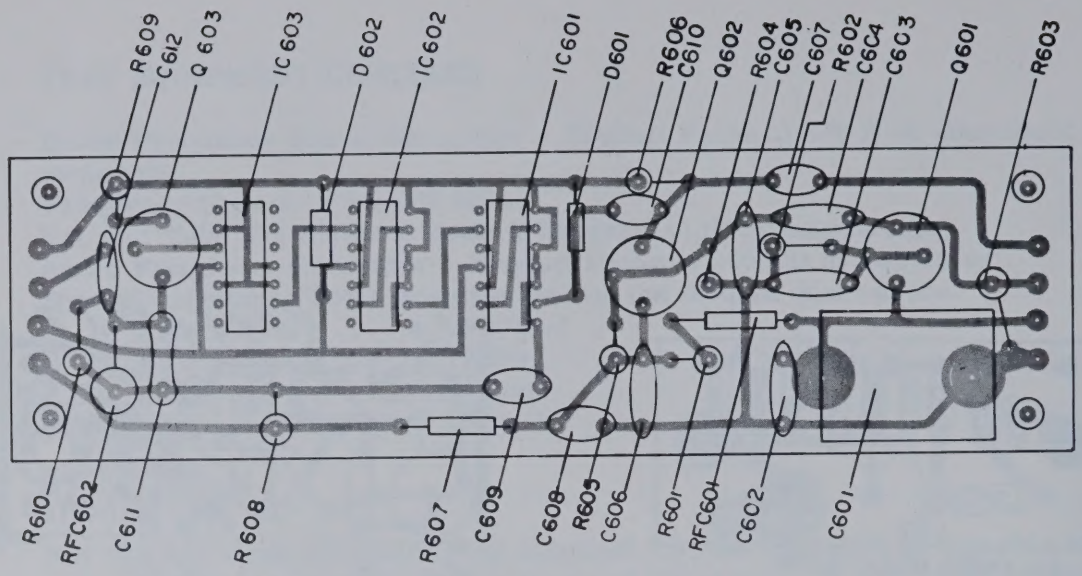


A 701
FIRST OSCILLATOR

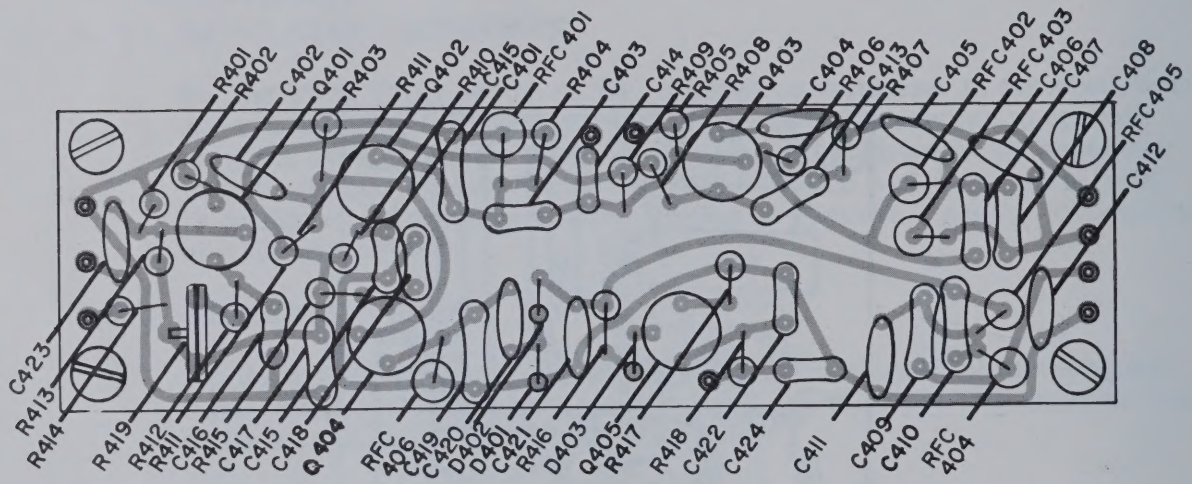


A801
AUDIO

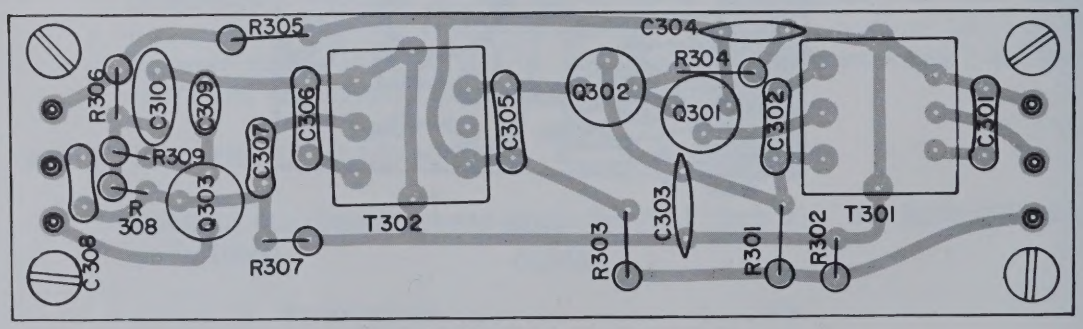
FIGURE 5. PRINTED CIRCUIT BOARDS



A 601 SECOND OSC/ DIVIDER



A 401 53 KHZ IF AMP



A 301 1650 KHZ IF

FIGURE 6. PRINTED CIRCUIT BOARDS

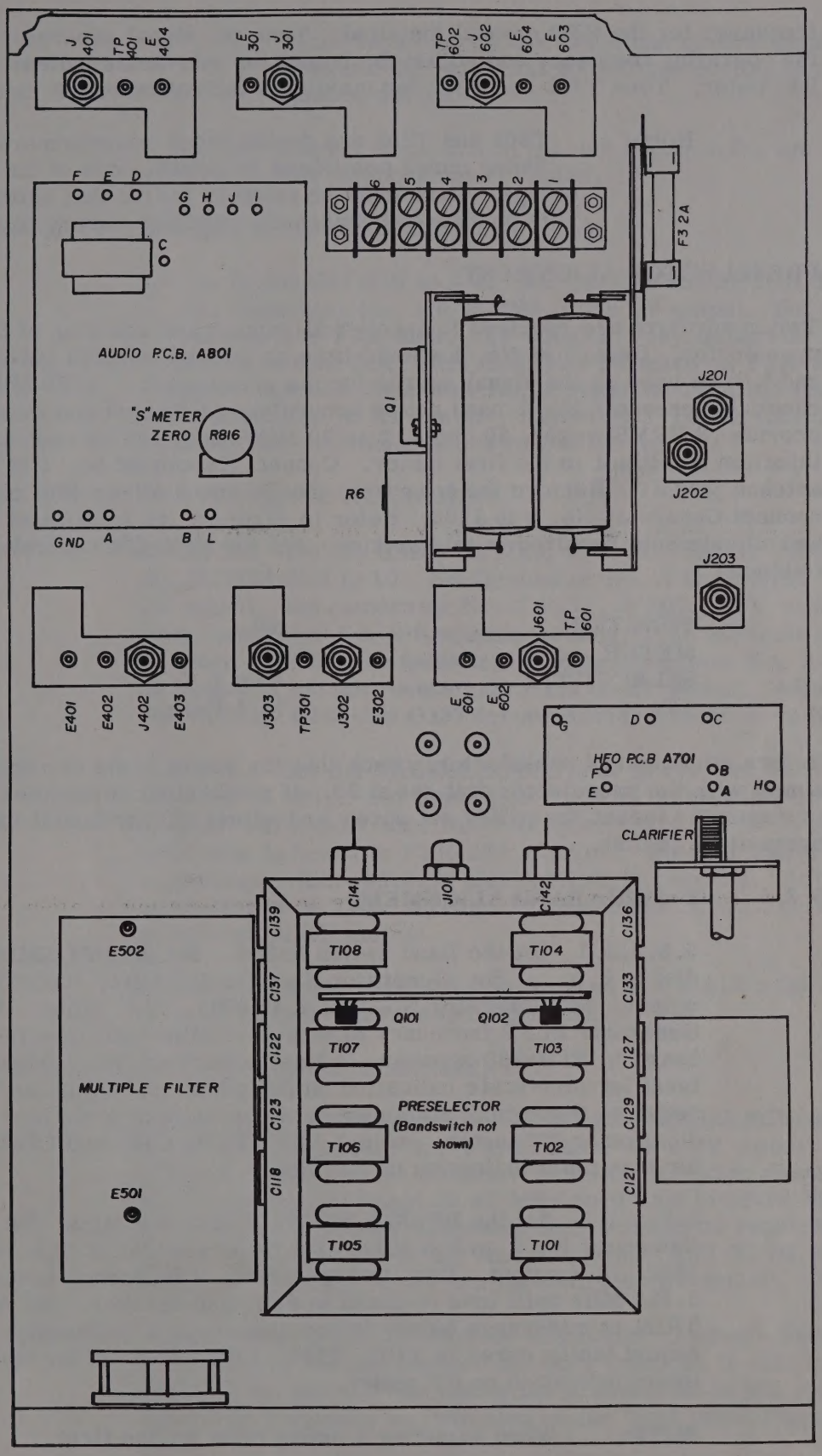


FIGURE 7. BOTTOM VIEW

frequency for the HFO crystal installed. Tune the signal generator to the operating frequency and adjust the output for mid-scale indication on RF meter. Tune T301 and T302 for maximum indication on RF meter.

Note: T301 and T302 are double tuned transformers with tuning cores positioned to outside ends of the windings. Care must be taken to insure that neither core is positioned between the windings during alignment.

5.3.5 PRESELECTOR ALIGNMENT

Two generators are required for proper alignment and tracking of the preselector. Generator No. 1 should have an internal crystal calibrator and will be used as the signal source for the preselector. (2-30 MHz range). Generator No. 2 need not be accurately calibrated and must provide .3 VRMS output, 50 ohms, 2 to 30 MHz range, to be used as the injection oscillator to the first mixer. Connect Generator No. 1 to the antenna jack J1. Remove the coax from the Balanced Mixer J202 and connect Generator No. 2 to J202. Refer to Figure 7 for location of J202 and adjustments required in this section. Set the FFR-230 controls as follows:

FUNCTION ..... SB
METER ..... RF
SELECTIVITY ..... USB 2.1
AF ..... Mid-Range

Before alignment of preselector, check that the tuning arms are horizontal with the preselector dial set at 20. If mechanical adjustment is required, loosen the pulley set screw and adjust for horizontal tuning arms at 20 on dial.

5.3.5.1 2-4 MHz BAND ALIGNMENT

5.3.5.1.1 Set the Band Switch to 2-4. Set the PRESELECTOR dial to 2.5. Set Generator No. 1 to 2.5 MHz, 1000 UV output. Set Generator No. 2 to 4.15 MHz, .3 V output. Vary Generator No. 2 frequency around 4.15 MHz until tone is heard in FFR-230 speaker. Adjust Generator No. 1 output level for mid-scale indication on RF meter and adjust as required throughout alignment to maintain mid-scale indication on RF meter. Adjust ANT TRIM, C129 and C133 for maximum indication on RF meter.

5.3.5.1.2 Set the PRESELECTOR dial to 3.5 MHz. Set Generator No. 1 to 3.5 MHz. Set Generator No. 2 to 5.150 MHz, .3 V output. Vary Generator No. 2 frequency around 5.150 MHz until tone is heard in FFR-230 speaker. Set ANT TRIM to mid-range (screwdriver slot vertical to chassis). Adjust tuning cores in T101, T102, T103 and T104 for maximum indication on RF meter.

NOTE: When adjusting a tuning core for the first

time, turn counterclockwise one or two turns to break the "set" that sometimes occurs in the tension device.

5.3.5.1.3 Repeat steps 5.3.5.1.1 and 5.3.5.1.2 a few times until no further improvement is noted.

5.3.5.2 4-8 MHz BAND ALIGNMENT

Set the BAND SWITCH to 4-8. Set the PRESELECTOR dial to 6. Set Generator No. 1 to 6 MHz, 1000 UV output. Set Generator No. 2 to 7.65 MHz, .3V output. Vary Generator No.2 frequency around 7.65 MHz until tone is heard in FFR-230 speaker. Reduce Generator No. 1 output as required for mid-scale indication on RF meter. Adjust ANT TRIM, C121, C127, and C136 for maximum indication on RF meter.

5.3.5.3 8-16 MHz BAND ALIGNMENT

5.3.5.3.1 Set the BAND SWITCH to 8-16. Set the PRE-SELECTOR dial to 10. Set Generator No. 1 to 10 MHz, 1000 UV output. Set Generator No. 2 to 11.65 MHz, .3V output. Vary Generator No. 2 frequency around 11.65 MHz until tone is heard in FFR-230 speaker. Reduce Generator No. 1 output as required for mid-scale indication on RF Meter. Adjust ANT TRIM, C123 and C137 for maximum indication on RF meter.

5.3.5.3.2 Set the PRESELECTOR dial to 14. Set Generator No. 1 to 14 MHz. Set Generator No.2 to 15.65 MHz, .3 V output. Vary Generator No. 2 frequency around 15.65 MHz until tone is heard in FFR-230 speaker. Set ANT TRIM to mid-range. (Screwdriver slot vertical to chassis). Adjust tuning cores in T105, T106, T107 and T108 for maximum indication on RF meter.

5.3.5.3.3 Repeat steps 5.3.5.3.1 and 5.3.5.3.2 a few times until no further improvement is noted.

5.3.5.4 16-30 MHz BAND ALIGNMENT

Set the BAND SWITCH to 16-30. Set the PRESELECTOR dial to 24. Set Generator No. 1 to 24 MHz, 1000 UV output. Set Generator No. 2 to 25.65 MHz, .3 V output. Vary Generator No. 2 frequency around 25.65 MHz until tone is heard in FFR-230 speaker. Reduce Generator No. 1 output as required for mid-scale indication on RF meter. Adjust ANT TRIM, C118, C122 and C139 for maximum indication on RF meter.

5.3.5.5 This completes the preselector alignment. Remove Generator No. 2 from J202 and replace the coax removed in step 5.3.4. Refer to section 3.3 for tuning the preselector to the proper operating frequency as indicated on the front panel frequency plate.

5.4 TROUBLESHOOTING

This paragraph contains general information about basic characteristics to aid service personnel in isolating circuit malfunctions and repairing the receiver. It has been our experience that the following systematic steps be followed to locate a receiver malfunction.

5.4.1 VISUAL INSPECTION

5.4.1.1 Check the front panel controls to determine if the receiver is properly tuned for the mode of operation.

5.4.1.2 Inspect the cables and connectors on the rear of the receiver and make certain that they are in place.

5.4.1.3 Remove bottom covers and inspect the top and bottom of the radio for shorts, broken wires, or broken parts.

5.4.2 RECEIVER CONTROL SETTINGS

Pre-set the FFR-230 controls as follows:

BAND..... As applicable to channel or frequency of crystal installed.
PRESELECTOR ..... Set to channel frequency.
SELECTIVITY ..... Set to AM 6.0 KHz.
CLARIFIER ..... Mid-range.
METER ..... to RF.
FUNCTION ..... to SB.

5.4.3 MODULE DC AND AC VOLTAGES

With the aid of Figures 5 and 7, the following table of voltages should be checked. These measurements are made with the function switch in the sideband position and no signal applied to the receiver. These checks should be made with a suitable VTVM (410B).

Terminal	Use	Voltage
C141	Preselector	11.8 VDC
E302	1650 KHz IF	11.8 VDC
E404	50 KHz IF	11.8 VDC
E603	Osc/Divider	11.8 VDC
A701-G	HFO	11.8 VDC
A701-H	HFO	11.8 VDC
A801-B	Audio	12.2 VDC
C142	Preselector	3.6 VDC
E301	1650 KHz IF	3.6 VDC
E604	Osc/Divider	3.9 VDC
TP601	Osc Output	1.1 VAC
TP602	Divider Output	8 VAC
A701-E	HFO Output	.25 VAC

5.4.4 MALFUNCTION ISOLATION BY SIGNAL SUBSTITUTION

5.4.4.1 AUDIO CHECK

With the aid of Figure 7, the following procedure should be followed. Set the FUNCTION switch to STBY and the METER to AF. Connect a 600 ohm termination across J3A and J3C. Connect an audio generator to E402 of the 50 KHz IF Module, adjust generator for 1000 Hz at 100 millivolts RMS. Set the FUNCTION switch to AM. Adjust AF Gain Control until AF meter reads approximately "O" on the scale. If unable to obtain proper output, troubleshoot the AF output board A801.

5.4.4.2 RF CIRCUIT CHECK

With the aid of Figure 7, the following procedure should be followed. The following sections may be checked by signal substitution at various module inputs, starting at the 50 KHz IF Module and progressing back to the antenna. The generator used should have a 50 ohm source impedance and you should pre-set all receiver controls as in 5.4.2. Connect the generator to the following jacks on the frequency indicated. Advance the output control of the generator slowly until the front panel meter begins to move.

Connect Generator To	Generator Frequency	Typical Generator Voltage
J401	53.226 KHz	150 uv
J402	53.226 KHz	400 uv
J301	1650 KHz	3 MV
J201	Channel Frequency	10 uv
J1	Channel Frequency	1-3 uv

When a point is found that requires considerably more signal than indicated, the trouble is between this point and the last check point. Note: Before proceeding further, check the coaxial cables with an ohm meter for a possible open or shorted condition.

5.4.5 TRANSISTOR VOLTAGE CHECKS

The following table of voltages may be used to further isolate a problem after it has been localized to particular module or section of the receiver. The measurements were taken with a Hewlett Packard 410B VTVM. Refer to Figures 5, 6, 8 and the individual module schematic diagrams. Be certain that proper basing is observed when installing all semi-conductors.

TRANSISTOR DC VOLTAGES

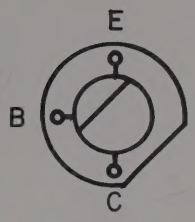
FFR-230

	Emitter	Base	Collector
Q1	16.5-18.5	16.5-18.5	12.2
Q2	6.5	7.1	16.5-18.
Q101	2.8	3.6	11
Q102	2.8	3.6	10
Q301	2.9	3.7	11.5
Q302	2.9	3.7	11.5
Q303	9.6	8.9	0
Q401	8.8	8.1	.58
Q402	8.6	7.9	.15
Q403	8.9	8.7	.87
Q404	8.6	7.9	.15
Q405	0	.12	3.6
Q602	5.0	5.6	11.0
Q603	.47	.85	11.0
Q702	4.1	4.9	11.8
Q801	2.2	2.9	12.0

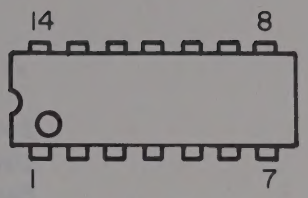
	Drain	Source	Gate
Q601	5.8	1.2	0
Q701	5.3	1.3	0

Integraged Circuits

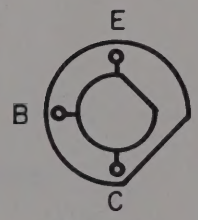
IC 601	1, 3, 4, 5, 7, 10, 12	0V
	2	.4V
	6, 13	.8V
	9	.8V
	11	3.9V
IC 602	1, 3, 4, 5, 7, 10, 12	0V
	2	.8V
	6, 13	.8V
	9	.8V
	11	3.9V
IC 603	3, 4, 9, 12	0V
	2	.8V
	10	.8V
	11	3.9V
IC 801	3	8.1V
	5	12.2V
	7	6.8V
	8	0V
	10	7V
	12	1.3V
	14	1.3V



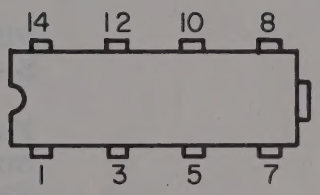
TOP VIEW
2N2926
2N3414



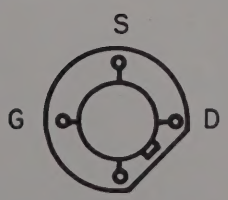
TOP VIEW
MC 723 P
MC 890P



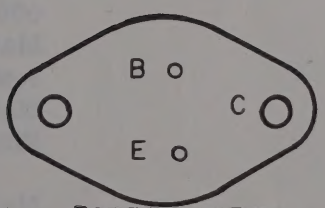
TOP VIEW
2N 3563
2N 4916



TOP VIEW
PA 237



TOP VIEW
3N 128



BOTTOM VIEW
2N1535

FIGURE 8. SEMICONDUCTOR BASING DIAGRAM

SECTION 6

PARTS LIST

MAIN CHASSIS

Symbol	Description	Galaxy Part No.
C1	2000 uF 25V electrolytic	24-23
C2	1000 uF 16V electrolytic	24-45
C3	Same as C2	
C4	.01 uF GMV ceramic	20-5
C5	Same as C4	
C6	Same as C4	
C7	2-34 pF variable	25-30
C8	Same as C7	
D1	B5E5, 400 PIV 1A	112-3
D2	Same as D1	
D3	Same as D1	
D4	Same as D1	
D5	Zener, 5.0V 5% 1W	112-15
DS1	Pilot Lamp	113-18
XDS1	Socket, DS1	67-6
F1	Fuse, AGC .3A	114-23
F2	Same as F1	
F3	Fuse, AGC 2A	114-22
Spare	Same as F3	
XF1-2	Fuse holder, F1 and F2	66-1
XF3	Fuse holder, F3 and spare	66-5
HR1	Heating Oven	172-51
J1	Antenna	101-4
P1	Mating Connector for J1	101-5
J2	Primary Power	104-18
P2	Mating Connector for J2	104-19
J3	600 ohms Audio	101-6
P3	Mating Connector for J3	101-7
J4	8 ohms Audio	101-8
P4	Mating Connector for J4	101-9
J5	Phone Jack	102-1
M1	Meter, RF/AF	115-15
Q1	2N 1535	111-25
Q2	2N 3414	111-13

Symbol	Description	Galaxy Part No.
XQ2	Socket, Q2	61-24
R1	1500 ohms 10% 1/2W	10-3
R5	Same as R1	
R2	680 ohms 10% 1/2W	10-72
R3	47 ohms 10% 1/2W	10-29
R4	100 ohms 10% 1/2W	10-7
R6	3000 ohms variable WW	13-52
R7	10 ohms 5% 1W	11-22
R8	4700 ohms 10% 1/2W	10-36
R9	50 ohms 10% 5W	15-8
R10	5000 ohms variable comp.	13-49
S1	Switch, Function	53-51
S2	Switch, Meter	51-7
T1	Power Transformer	70-25
TB1	Barrier Strip, Mute	83-3
TB2	Barrier Strip, Power	83-2
X1	Crystal, Channel	117-11
X2	Crystal, 1703.226 KHz	117-43
Z1	Multiple Filter	A-500
Miscellaneous:		
	Coaxial Adapter, BNC to Phone Jack	106-3
	Alignment Tool, 9050-L	133-53
	Alignment Tool, 8606	133-54
	Alignment Tool, 5009	133-55
	Knob, Preselector	130-14-25
	Knobs, Selectivity, Clarifier, Band, AF and Function	130-14-24
	Operating Frequency Plate	133-51

PRESELECTOR COMPONENTS

C101	2-34 pF variable	25-30
C102	10 pF 5% NPO ceramic	20-92
C103	82 pF 5% silver mica	22-48
C107	Same as C103	
C104	30 pF 5% NPO ceramic	20-97
C105	220 pF 5% silver mica	22-23
C120	Same as C105	
C106	39 pF 5% NPO ceramic	20-99

Symbol	Description	Galaxy Part No.
C108	500 pF 5% silver mica	22-56
C109	20 pF 5% NPO ceramic	20-70
C110	1.5 pF 5% comp.	20-106
C114	Same as C110	
C111	.56 pF 5% comp.	20-1
C112	1 pF 5% comp.	20-4
C125	Same as C112	
C113	5 pF 5% comp.	20-107
C115	.82 pF 5% comp.	20-105
C116	130 pF 5% silver mica	22-47
C117	12 pF 5% NPO ceramic	20-109
C118	5-25 pF variable	26-6
C122	Same as C118	
C123	Same as C118	
C137	Same as C118	
C139	Same as C118	
C119	91 pF 5% silver mica	22-43
C121	8-50 pF variable	26-5
C127	Same as C121	
C129	Same as C121	
C133	Same as C121	
C136	Same as C121	
C124	68 pF 5% NPO ceramic	20-67
C126	7 pF 5% comp.	20-108
C128	25 pF 5% NPO ceramic	20-102
C135	Same as C128	
C143	Same as C128	
C130	200 pF 5% silver mica	22-49
C134	Same as C130	
C131	.01 uF GMV ceramic	20-5
C132	Same as C131	
C140	Same as C131	
C138	56 pF 5% NPO ceramic	20-101
C141	1000 pF feedthru	91-3
C142	Same as C141	
J101	Phono Jack	100-6
P101	Phono Plug	105-2
Q101	2N3563	111-15
Q102	Same as Q101	
XQ101-102	Socket, Q101 and 102	61-24
R101	47 ohms 10% 1/2W	10-29
R102	2200 ohms 10% 1/2W	10-31
R103	Same as R102	
R104	470 ohms 10% 1/2W	10-53
R105	1000 ohms 10% 1/2W	10-42
R106	100 ohms 10% 1/2W	10-7

Symbol	Description	Galaxy Part No.
S101	Switch, Band	53-52
T101	Transformer, 2-8 MHz	42-93
T102	Transformer, 2-8 MHz	42-94
T103	Transformer, 2-8 MHz	42-95
T104	Transformer, 2-8 MHz	42-96
T105	Transformer, 8-30 MHz	42-97
T106	Transformer, 8-30 MHz	42-98
T107	Transformer, 8-30 MHz	42-99
T108	Transformer, 8-30 MHz	42-100
Miscellaneous:		
	Tuning Core, T101 thru T108	46-1
	Reduction Ball Drive	172-12
	Pulley	172-35
	Pulley Spring	124-75
	Dial	172-53

BALANCED MIXER, A200

A201	Circuit Board, complete	A-201
C201	.002 uF 10% ceramic	20-104
C202	Same as C201	
D201	1N270	112-10
D202	Same as D201	
D203	Same as D201	
D204	Same as D201	
J201	Phono Jack	100-6
J202	Same as J201	
J203	Same as J201	
P201	Phono Plug	105-2
P202	Same as P201	
P203	Same as P201	
L201	8.2 uH, molded choke	30-44
L203	Same as L201	
L202	15 uH, molded choke	30-31
T201	Transformer	73-39
T202	Same as T201	
PCB201	Circuit Board, plated and drilled	200-65

1650 KHz IF MODULE, A300

Symbol	Description	Galaxy Part No.
A301	Circuit Board, complete	A-301
C301	820 pF 5% silver mica	22-14
C302	Same as C301	
C305	Same as C301	
C306	Same as C301	
C303	.02 uF +80 -20% ceramic	20-49
C304	Same as C303	
C307	470 pF 5% silver mica	22-61
C308	100 pF 5% silver mica	22-21
C309	10 uF 20V tantalum	28-1
C310	100 uF 20V tantalum	28-2
J301	Phono Jack	100-6
J302	Same as J301	
J303	Same as J301	
P301	Phono Plug	105-2
P302	Same as P301	
P303	Same as P301	
Q301	2N3563	111-15
Q302	Same as Q301	
Q303	2N4916	111-32
XQ301 thru 303	Socket, Q301 thru 303	61-33
R301	1000 ohms 10% 1/2W	10-42
R304	Same as R301	
R309	Same as R301	
R302	68K ohms 10% 1/2W	10-33
R303	47K ohms 10% 1/2W	10-13
R305	100 ohms 10% 1/2W	10-7
R306	Same as R305	
R307	12K ohms 10% 1/2W	10-84
R308	4700 ohms 10% 1/2W	10-36
RFC301	1 mH, molded choke	30-18
T301	Transformer	76-37
T302	Transformer	76-38
PCB301	Circuit Board, plated and drilled	200-56

53 KHz IF MODULE, A400

A401	Circuit Board, complete	A-401

Symbol	Description	Galaxy Part No.
C401	820 pF 5% silver mica	22-14
C407	Same as C401	
C408	Same as C401	
C409	Same as C401	
C410	Same as C401	
C419	Same as C401	
C402	.01 uF GMV ceramic	20-5
C420	Same as C402	
C423	Same as C402	
C403	18 pf 5% NPO ceramic	20-103
C404	.002 uF 10% ceramic	20-104
C405	Same as C404	
C406	Same as C404	
C411	Same as C404	
C412	Same as C404	
C421	Same as C404	
C413	100 uF 20V tantalum	28-2
C417	Same as C413	
C414	50 pF 5% NPO ceramic	20-84
C415	10 uF 20V tantalum	28-1
C416	Same as C415	
C418	Same as C415	
C422	47 uF 20V tantalum	28-3
C424	Same as C422	
D401	1N270	112-10
D402	Same as D401	
D403	1N462	112-5
J401	Phone Jack	100-6
J402	Same as J401	
P401	Phono Plug	105-2
P402	Same as P401	
Q401	2N4916	111-32
Q402	Same as Q401	
Q403	Same as Q401	
Q404	Same as Q401	
Q405	2N3414	111-13
XQ401 thru 405	Socket, Q401 thru 405	61-33
R401	12K ohms 10% 1/2W	10-84
R403	Same as R401	
R402	330 ohms 10% 1/2W	10-28
R404	15K ohms 10% 1/2W	10-81
R405	18K ohms 10% 1/2W	10-80
R406	10K ohms 10% 1/2W	10-56
R407	220 ohms 10% 1/2W	10-58

Symbol	Description	Galaxy Part No.
R412	Same as R407	
R408	6800 ohms 10% 1/2W	10-15
R409	4700 ohms 10% 1/2W	10-36
R411	Same as R409	
R413	Same as R409	
R410	1000 ohms 10% 1/2W	10-42
R415	Same as R410	
R414	100 ohms 10% 1/2W	10-7
R417	Same as R414	
R418	Same as R414	
R416	2.7 K ohms 10% 1/2W	10-66
R419	5000 ohms, variable	13-36
RFC401	10 mH molded choke	30-39
RFC402	Same as RFC401	
RFC403	Same as RFC401	
RFC404	Same as RFC401	
RFC405	Same as RFC401	
RFC406	Same as RFC401	
PCB401	Circuit Board, plated and drilled	200-54

SECOND OSC/FREQUENCY DIVIDER MODULE, A600

A601	Circuit Board, Complete	A-601
C601	2-54 pF variable	25-38
C602	30 pF 5% NPO ceramic	20-97
C603	.1 uF 20% polyester	20-38
C604	82 pF 5% silver mica	22-48
C605	130 pF 5% silver mica	22-47
C606	.01 uF GMV ceramic	20-5
C607	.001 uF 10% ceramic	20-24
C612	Same as C607	
C608	10 uF 20V tantalum	28-1
C609	Same as C608	
C610	100 pF 10% ceramic	20-23
C611	820 pF 5% silver mica	22-14
D601	1N270	112-10
D602	Zener, 3.6V 5% 1W	112-22
IC601	MC890P	111-41
IC602	Same as IC601	
IC603	MC723P	111-42
J601	Phono Jack	100-6

Symbol	Description	Galaxy Part No.
J602	Same as J601	
P601	Phono Plug	105-2
P602	Same as P601	
Q601	3N128	111-40
Q602	2N2926Y	111-6Y
Q603	Same as Q602	
XQ601	Socket, Q601	61-34
XQ602-603	Socket, Q602 and 603	61-33
R601	4700 ohms 10% 1/2W	10-36
R602	1000 ohms 10% 1/2W	10-42
R606	Same as R602	
R608	Same as R602	
R603	100K ohms 10% 1/2W	10-32
R604	12K ohms 10% 1/2W	10-84
R605	10Kohms 10% 1/2W	10-56
R607	100 ohms 10% 1/2W	10-7
R609	470 ohms 10% 1/2W	10-53
R610	15K ohms 10% 1/2W	10-81
RFC601	1 mH molded choke	30-18
RFC602	10 mH molded choke	30-39
PCB601	Circuit Board, plated and drilled	200-58

FIRST OSCILLATOR CIRCUIT BOARD, A701

A701	Circuit Board, complete	A-701
C701	12 pF 5% N750 ceramic	20-110
C702	10 pF 5% NPO ceramic	20-92
C703	.01 uF GMV ceramic	20-5
C707	Same as C703	
C708	Same as C703	
C704	.1 uF 20% polyester	20-38
C705	56 pF 5% NPO ceramic	20-101
C706	500 pF 5% silver mica	22-56
D701	Zener, 5V 5% 1W	112-15
Q701	3N128	111-40
Q702	2N3563	111-15
XQ701	Socket, Q701	61-34
XQ702	Socket, Q702	61-33
R701	1000 ohms 10% 1/2W	10-42

Symbol	Description	Galaxy Part No.
R702	100K ohms 10% 1/2W	10-32
R703	22Kohms 10% 1/2W	10-6
R704	Same as R703	
R705	820 ohms 10% 1/2W	10-75
R706	180 ohms 10% 1/2W	10-71
R707	47 ohms 10% 1/2W	10-29
RFC701	400 uH choke	30-7
PCB701	Circuit Board, plated and drilled	200-57

AUDIO CIRCUIT BOARD, A801

A801	Circuit Board, complete	A-801
C801	.1 uF 20% polyester	20-38
C802	.001 10% ceramic	20-24
C803	10 uF 20V tantalum	28-1
C804	Same as C803	
C805	.05 uF +80 -20% ceramic	20-56
C806	100 uF 20V tantalum	28-2
D801	1N270	112-10
D804	Same as D801	
D805	Same as D801	
D806	Same as D801	
D807	Same as D801	
D809	Same as D801	
D802	1N462	112-5
D803	Same as D802	
IC801	PA237	111-33
Q801	2N2926Y	111-6Y
XQ801	Socket, Q801	61-33
R801	56K ohms 5% 1/2W	10-103
R805	Same as R801	
R802	390K ohms 5% 1/2W	10-101
R803	560 ohms 10% 1/2W	10-67
R815	Same as R803	
R804	15K ohms 10% 1/2W	10-81
R806	180K ohms 5% 1/2W	10-102
R807	6800 ohms 10% 1/2W	10-15
R809	22 ohms 10% 1/2W	10-22
R810	33 ohms 10% 1/2W	10-100

Symbol	Description	Galaxy Part No.
R811	10 ohms 10% 1/2W	10-52
R812	220 ohms 10% 1/2W	10-58
R813	470 ohms 10% 1/2W	10-53
R814	1000 ohms 10% 1/2W	10-42
R816	100K ohms, variable	13-41
R817	10K ohms 10% 1/2W	10-56
R818	33K ohms 10% 1/2W	10-65
T801	Transformer, 600 ohm output	70-16
PCB801	Circuit Board, plated and drilled	200-55

SECTION 7

WARRANTY

GALAXY ELECTRONICS guarantees to remedy any defect in material or workmanship existing in the FFR-230 at no cost to the owner, exclusive of shipping charges, provided:

- That the defect is not caused by improper installation or use contrary to our instruction.
- That the unit serial number has been registered with us by the original purchaser.
- That the equipment or part that appears defective is delivered to us or the authorized repair station, we may designate for examination.
- That this examination, in our judgement, discloses a defective part or workmanship.

This warranty applies to labor and all semi-conductor devices for a period of 90 days. All other parts for a period of one year from the date of purchase by the original owner. This warranty applies only to the original purchaser and is not transferable. This warranty does not cover any transportation costs that may be incurred, and our sole liability is repair of any defect, for the period stated above.

No person is authorized to assume for us any other liability in connection with the sale of this or other of our products.

GALAXY ELECTRONICS reserves the right to make any change that is necessary or desirable by us to the product, without advance notice, or incurring any obligation to make like changes or improvements in units previously manufactured or sold.

All warranty expressed here are void and terminated one year after the last FFR-230 receiver has been manufactured by us.

SERVICE INFORMATION

WARRANTY PARTS REPLACEMENT:

If any component in the FFR-230 should fail during warranty period and a replacement part is needed, please mail the defective part, with a letter of instruction to GALAXY ELECTRONICS, Customer Service Department. On receipt of this defective component a new part will be sent to you immediately.

RETURNING EQUIPMENT FOR SERVICE:

Do not ship equipment to GALAXY ELECTRONICS without prior written permission. We prefer to send special shipping labels to avoid delay of unexpected shipments. If time is extremely important, it is better to wire or call us for approval and we will rush shipping labels to you. When a shipment is expected, even the time of sending labels to you is less than that loss when an unexpected shipment is received.

It is very important that the shipment be well packed and fully insured. Damage claims must be settled between you and the carrier and it will greatly delay any returns. Proper packing normally avoids this trouble.

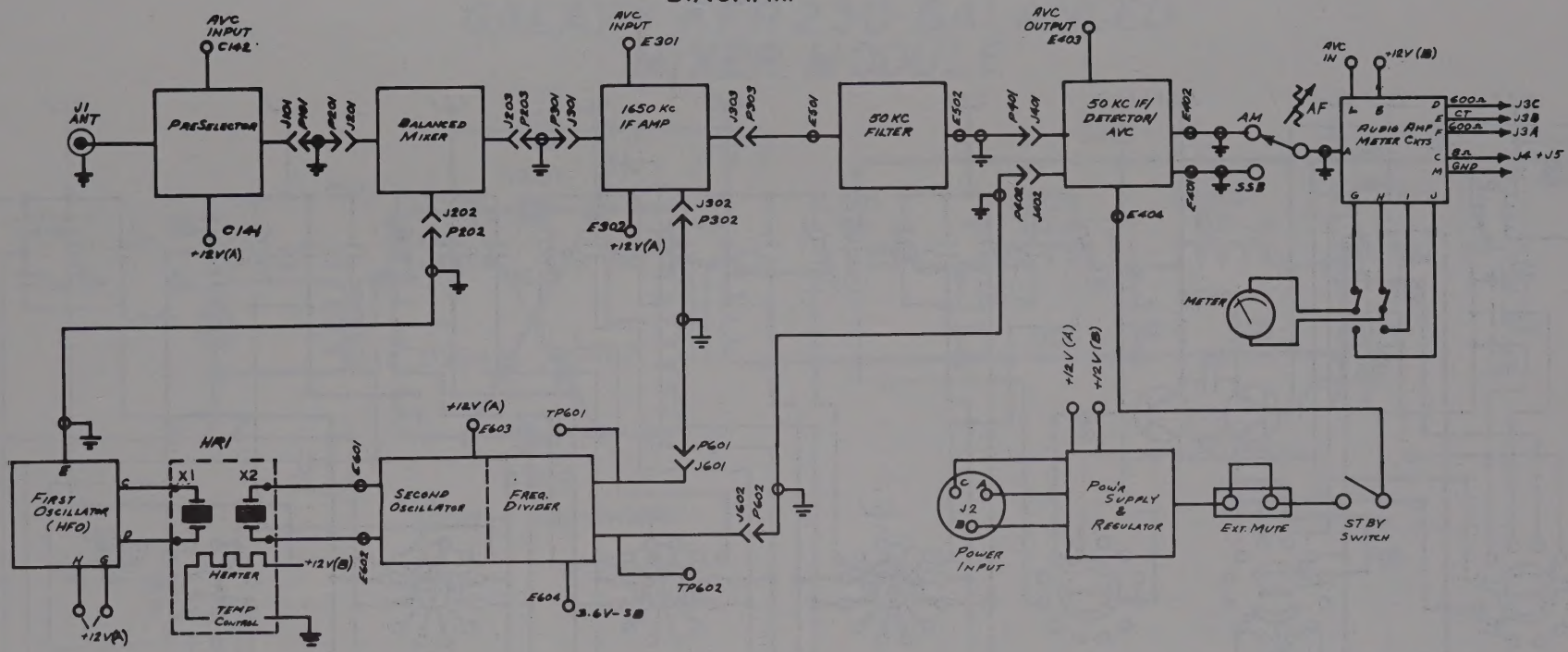
All returns should be made in our standard cartons only -- so save your carton when unpacking your unit.

All correspondence relating to warranty service, warranty parts replacement, parts orders, or other service should be directed:

GALAXY ELECTRONICS INC.
a subsidiary of
HY-GAIN ELECTRONICS CORP.
Rural Route 3
Lincoln, Nebraska 68505

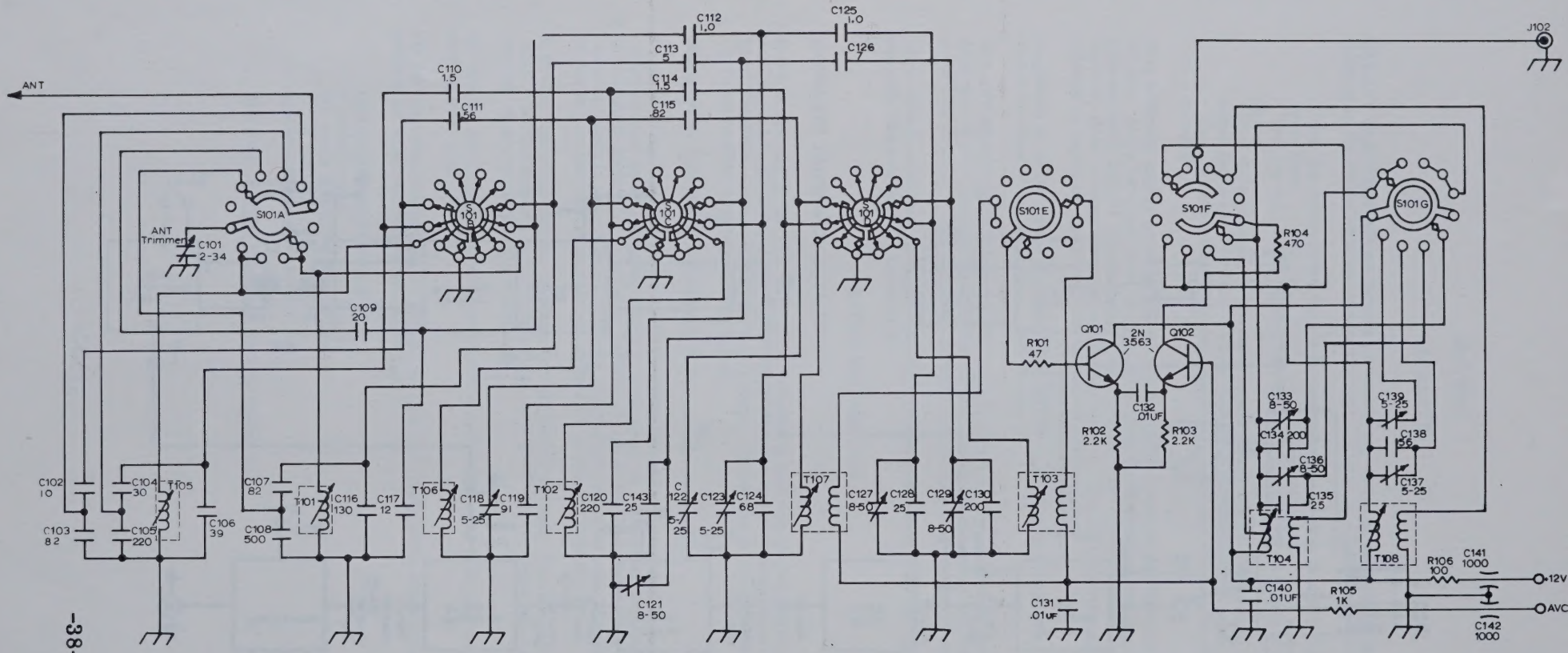
Attention: Galaxy Customer Service Department

GALAXY FFR 230 MODULE INTER-CONNECTION DIAGRAM

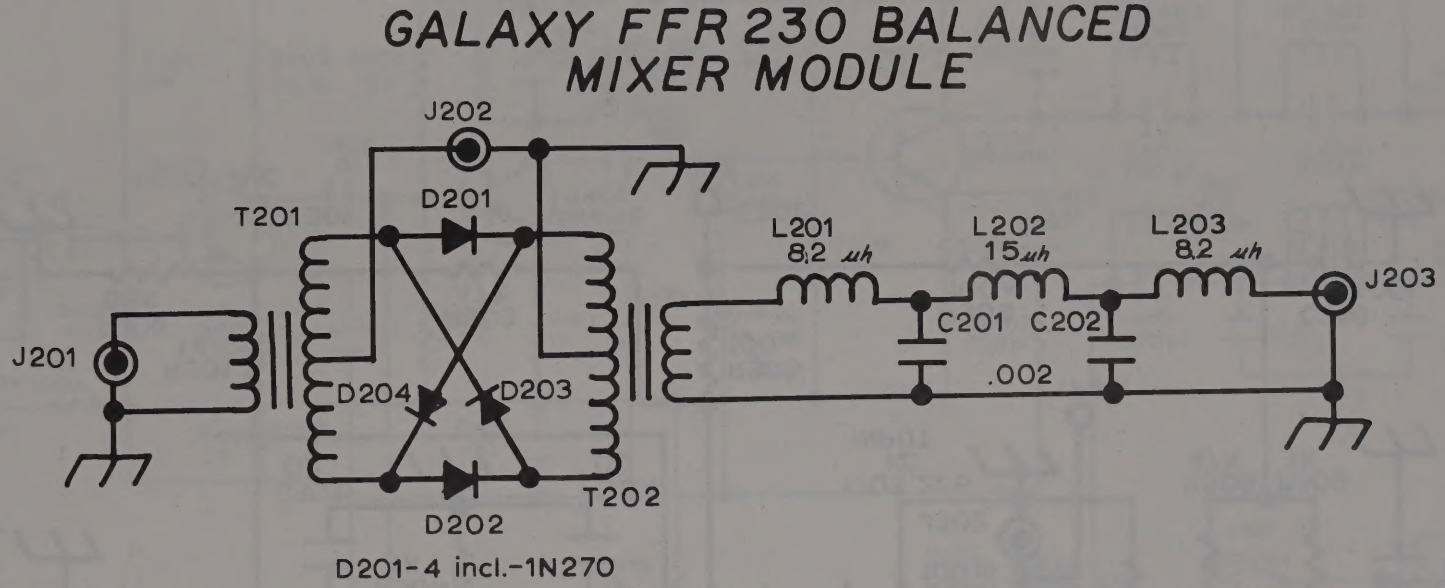


FFR-230 INTERCONNECTION DIAGRAM

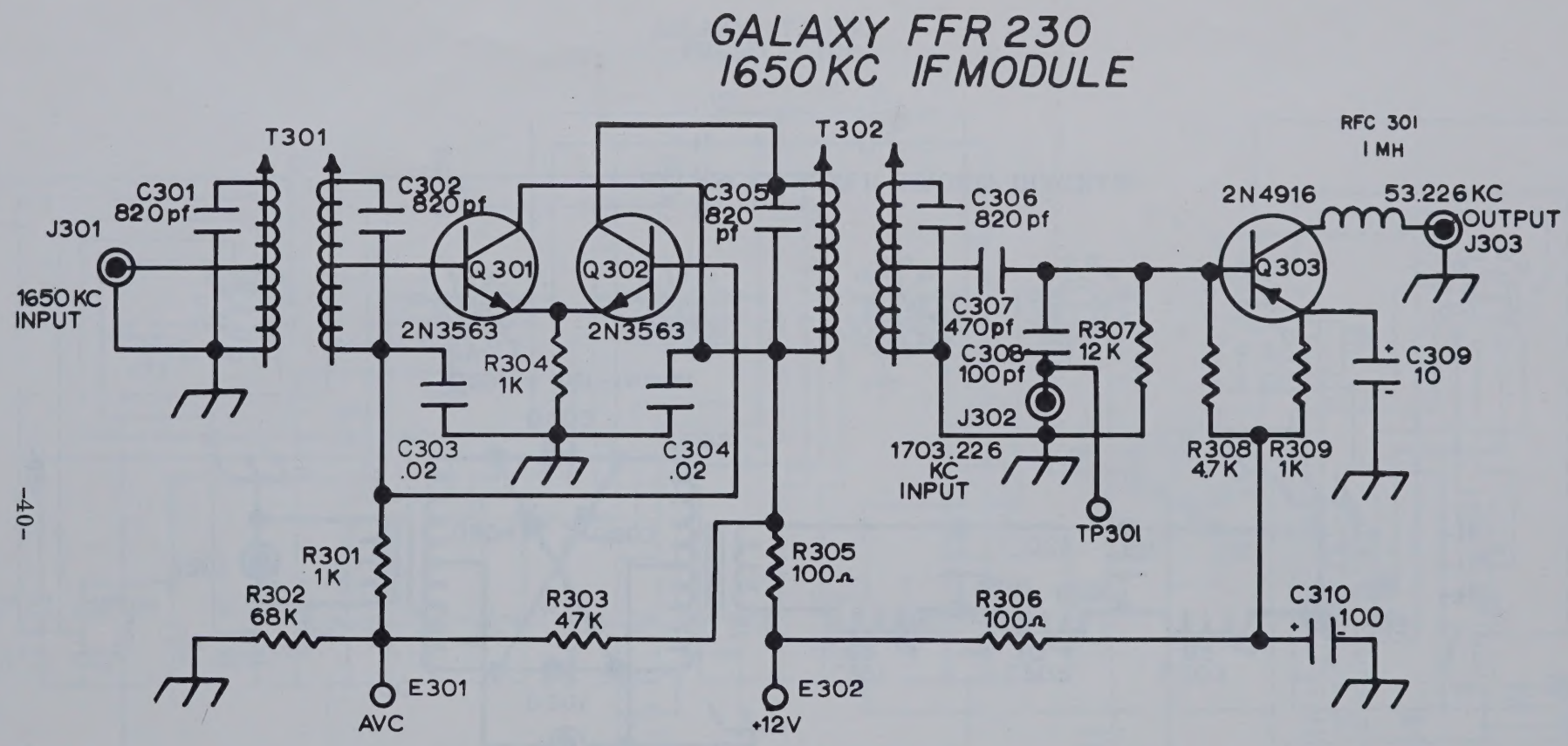
GALAXY FFR 230
PRESELECTOR



PRESELECTOR CIRCUIT DIAGRAM

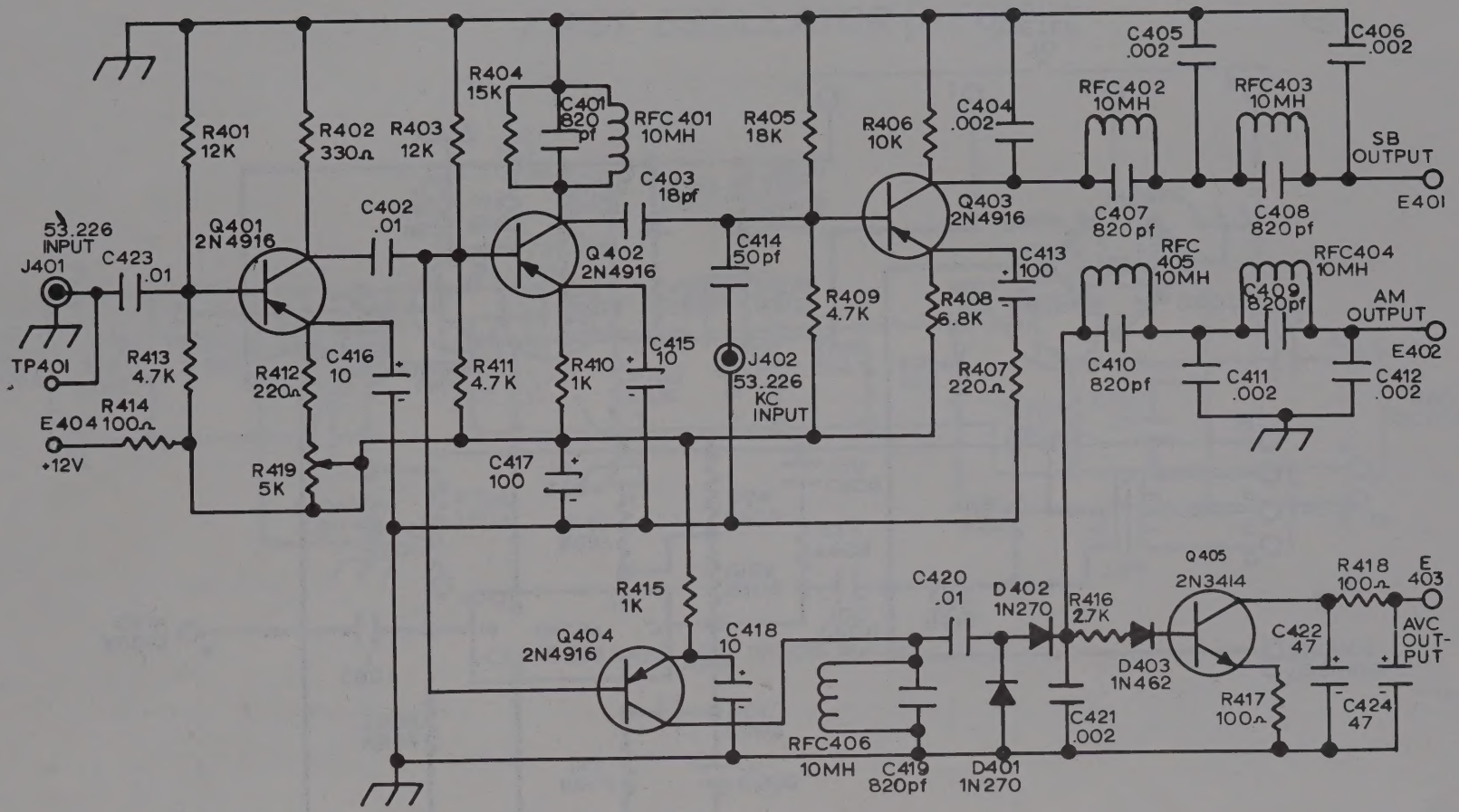


BALANCED MIXER CIRCUIT DIAGRAM



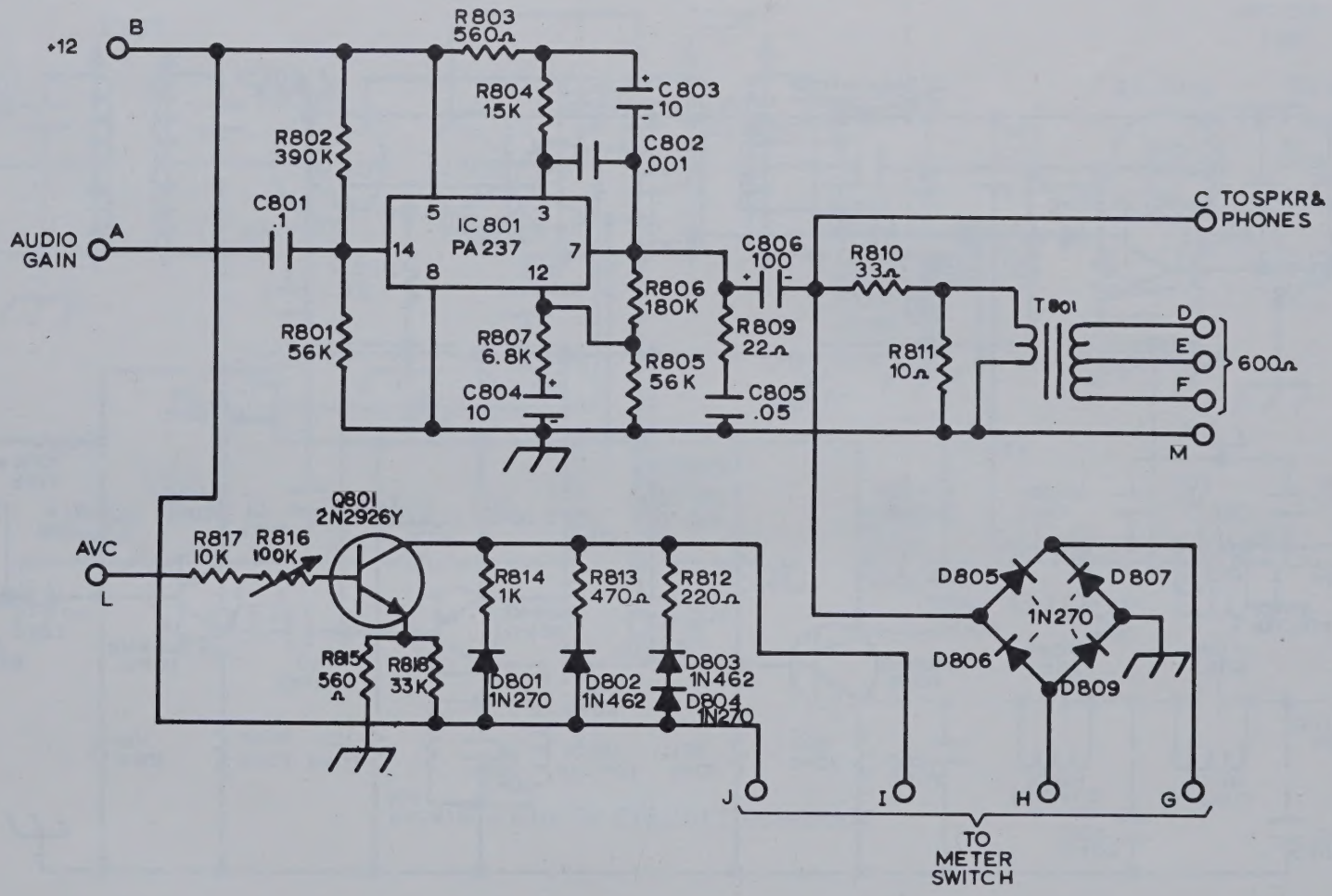
1650 KHz IF CIRCUIT DIAGRAM

GALAXY FFR230 53KC IF AMP./ DETECTOR/AVC



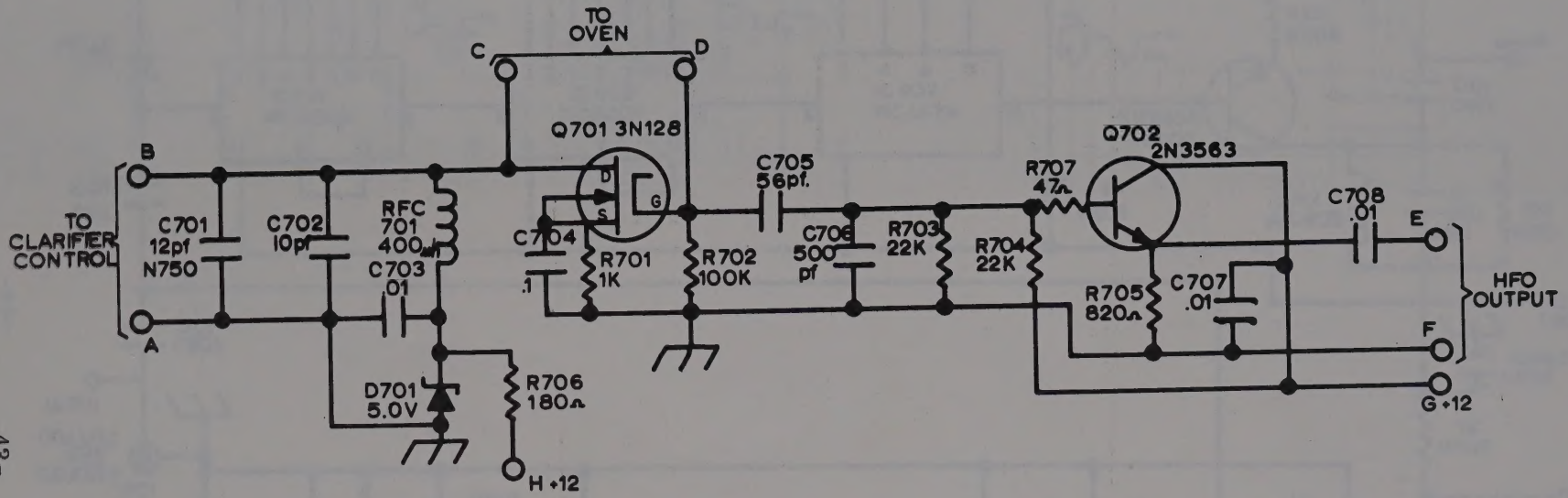
53 KHz IF CIRCUIT DIAGRAM

GALAXY FFR230 AUDIO AMP & METER CIRCUITRY



AUDIO CIRCUIT DIAGRAM

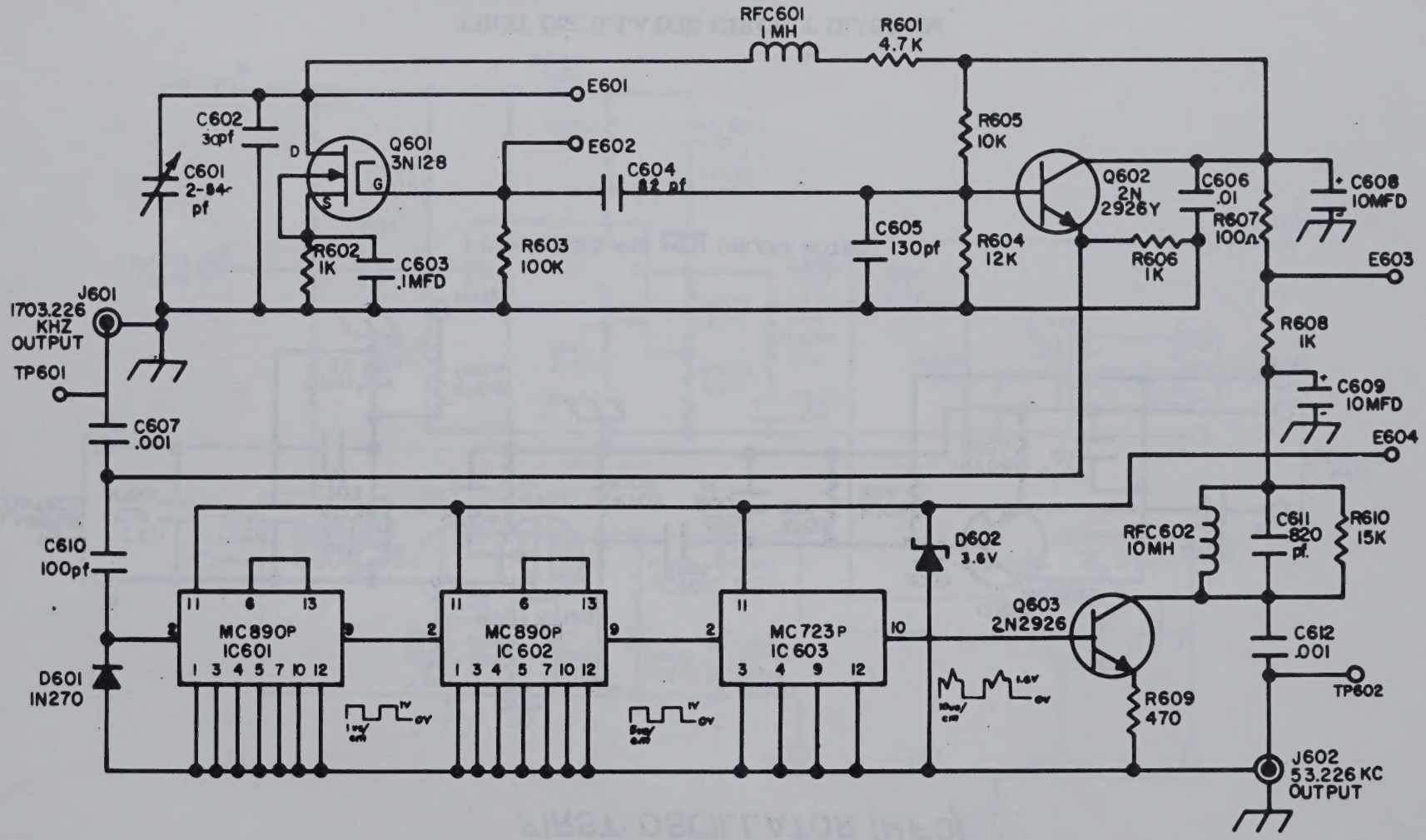
GALAXY FFR 230
FIRST OSCILLATOR (HFO)



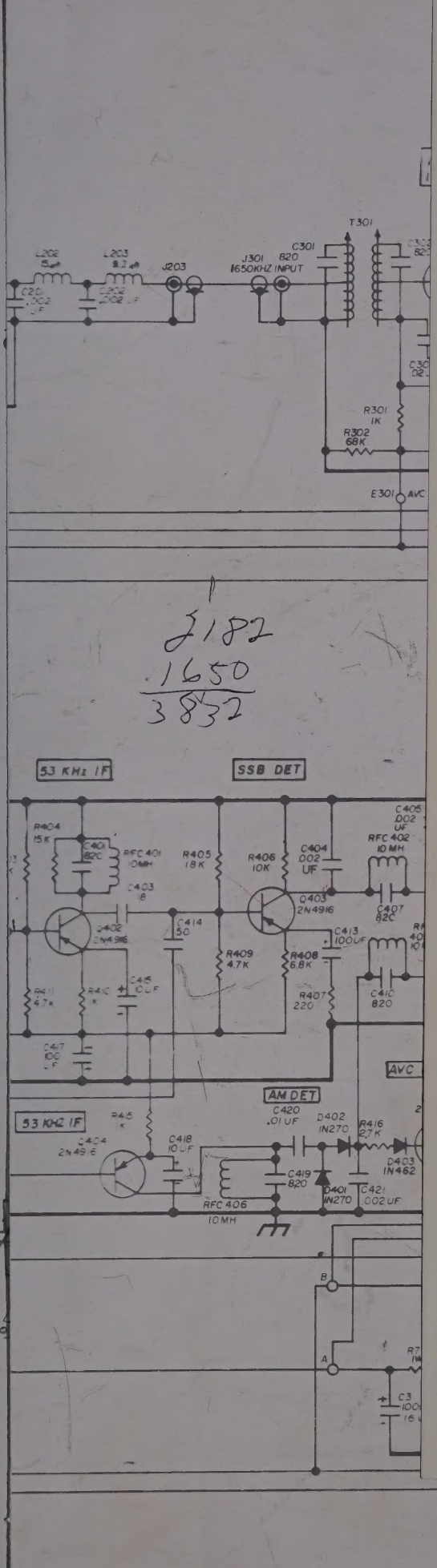
CAP. VALUES ARE MFD UNLESS NOTED

FIRST OSCILLATOR CIRCUIT DIAGRAM

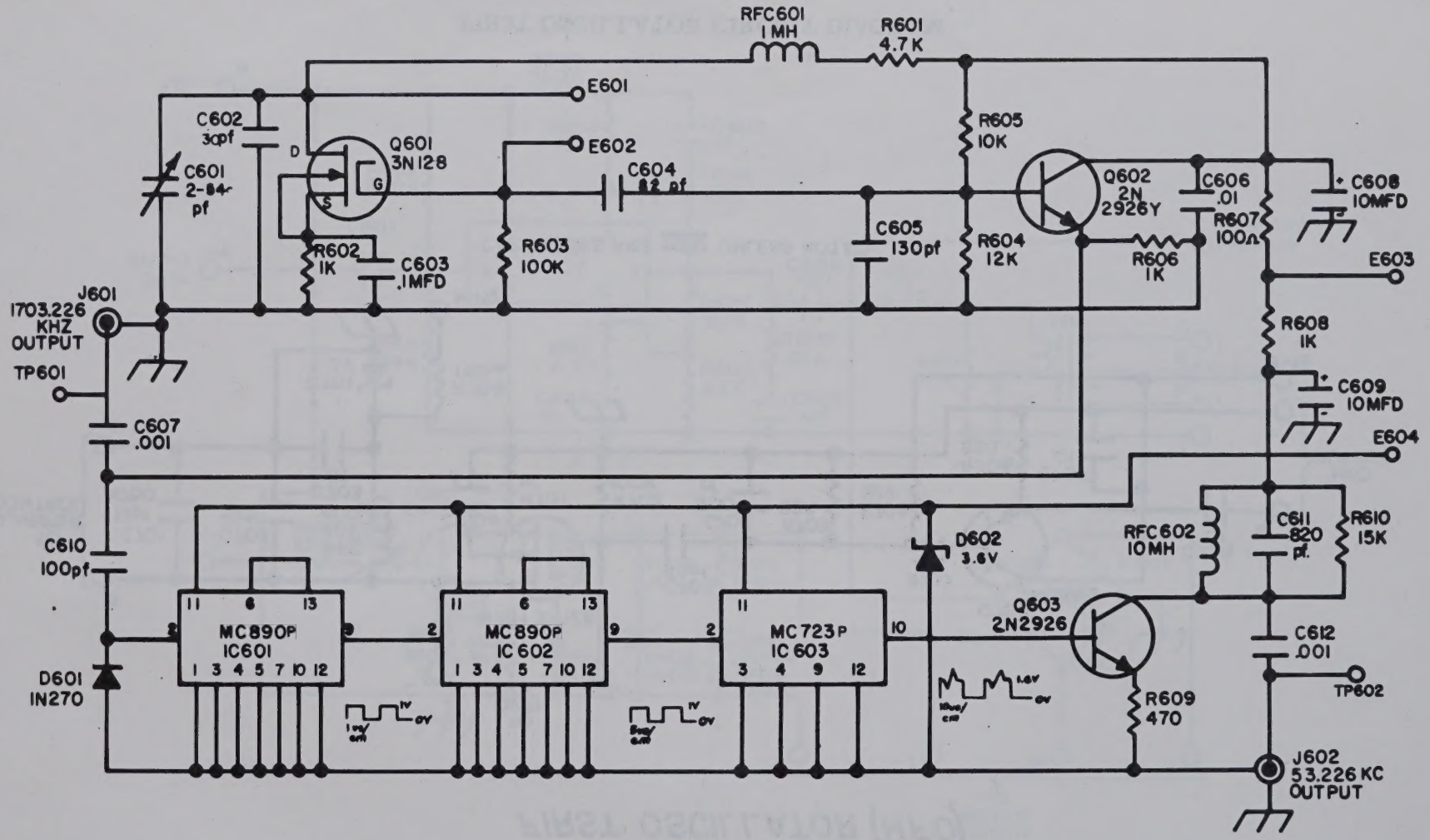
GALAXY FFR230 SECOND OSCILLATOR/ FREQUENCY DIVIDER MODULE



SECOND OSCILLATOR/DIVIDER CIRCUIT DIAGRAM

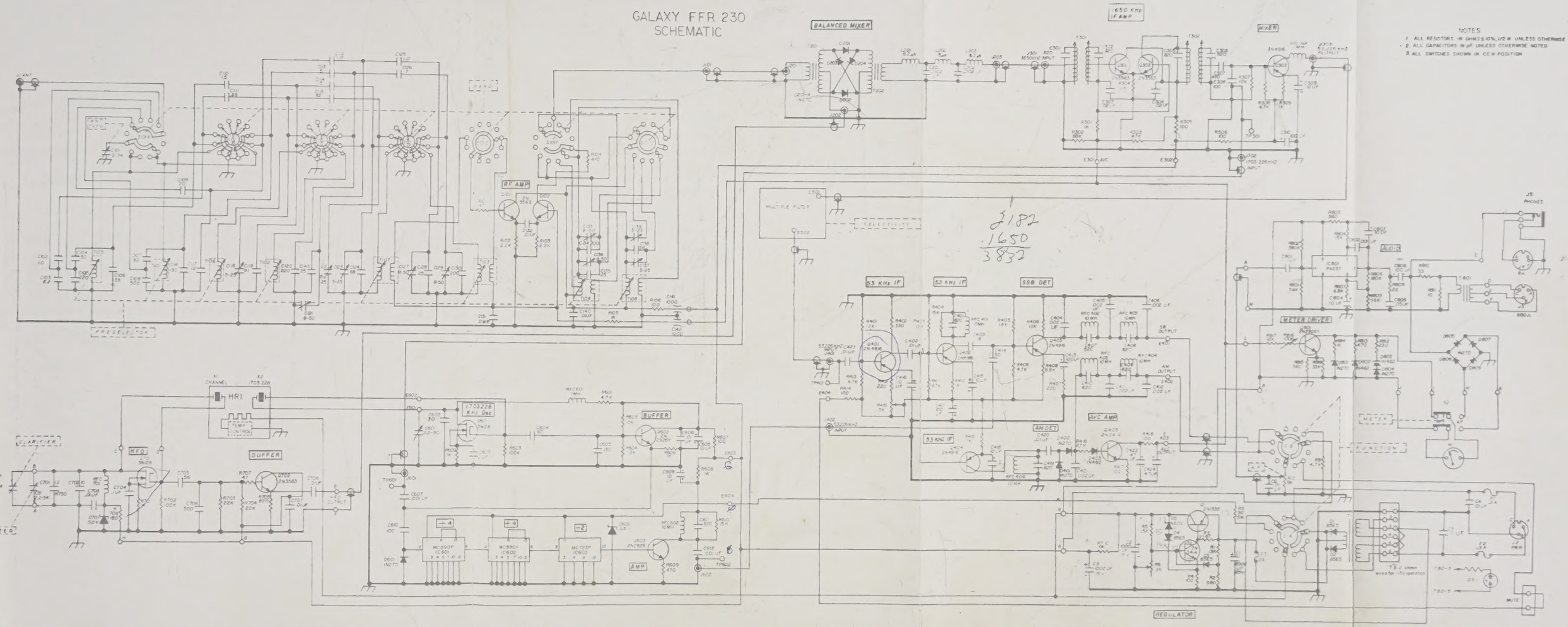

T301
C301
820
J301
1650KHZ INPUT
J203
L202
L203
C202
.002 UF
R301
1K
R302
68K
E301
AVC
2182
1650
3832
53 KHz IF
SSB DET
R404
15K
C401
820
RFC 401
10MH
R405
18K
R406
10K
C404
.002
UF
RFC 402
10 MH
C405
.002
UF
C403
.8
Q403
2N4916
C407
82C
Q402
2N4916
C414
150
C413
100UF
R409
4.7K
R408
6.8K
R411
4.7K
R410
K
C415
.001 UF
R407
220
C410
820
C417
100
UF
AVC
AM DET
53 KHz IF
R45
K
C420
.01 UF
D402
IN270
R416
2.7K
C404
2N4916
C418
10 UF
C419
820
D401
IN270
C421
.002 UF
D403
IN462
RFC 406
10MH
B
A
C7
22-34
FREQ
R7
C3
100
16

GALAXY FFR230 SECOND OSCILLATOR/ FREQUENCY DIVIDER MODULE



SECOND OSCILLATOR/DIVIDER CIRCUIT DIAGRAM

GALAXY FFR 230
SCHEMATIC



GALAXY FFR230 SECOND OSCILLATOR